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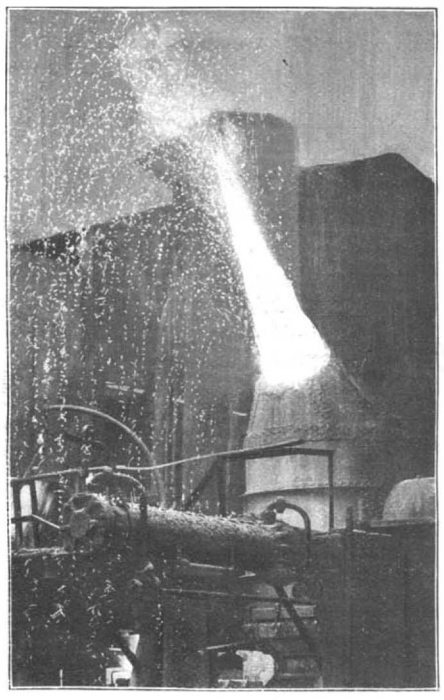

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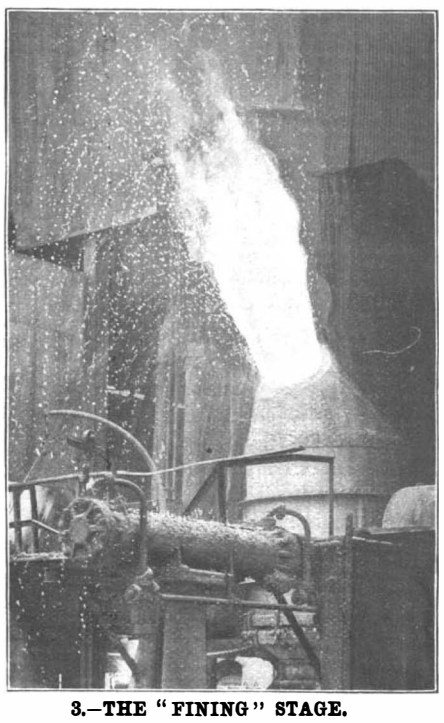

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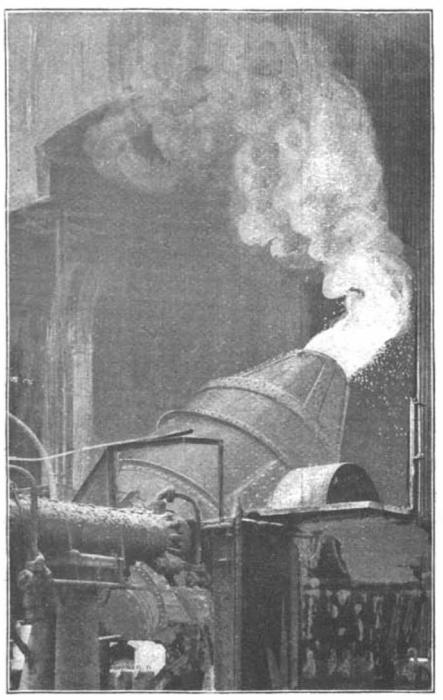

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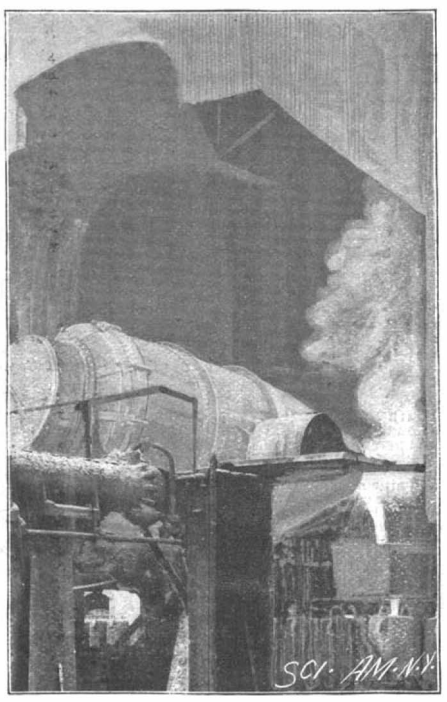

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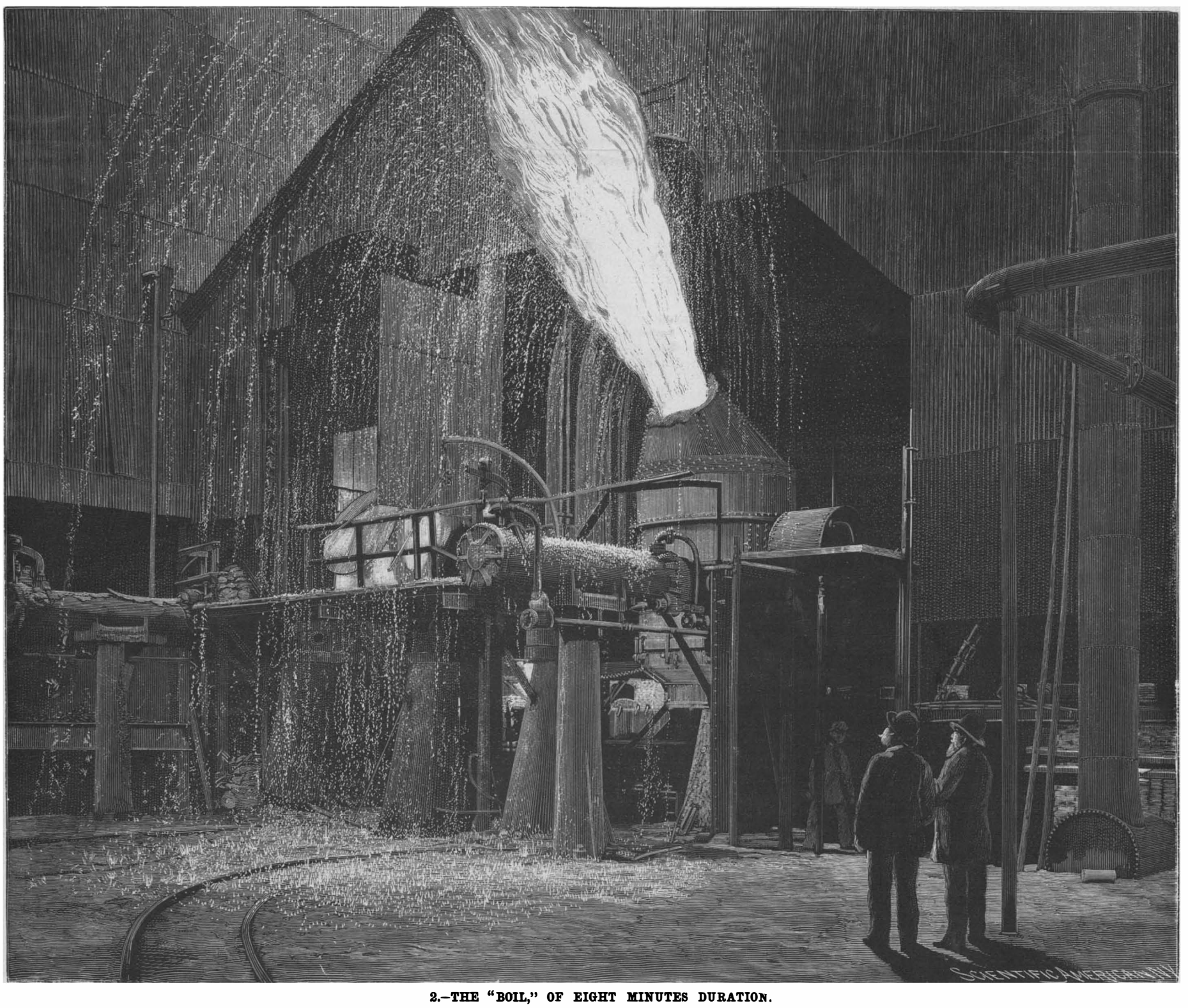

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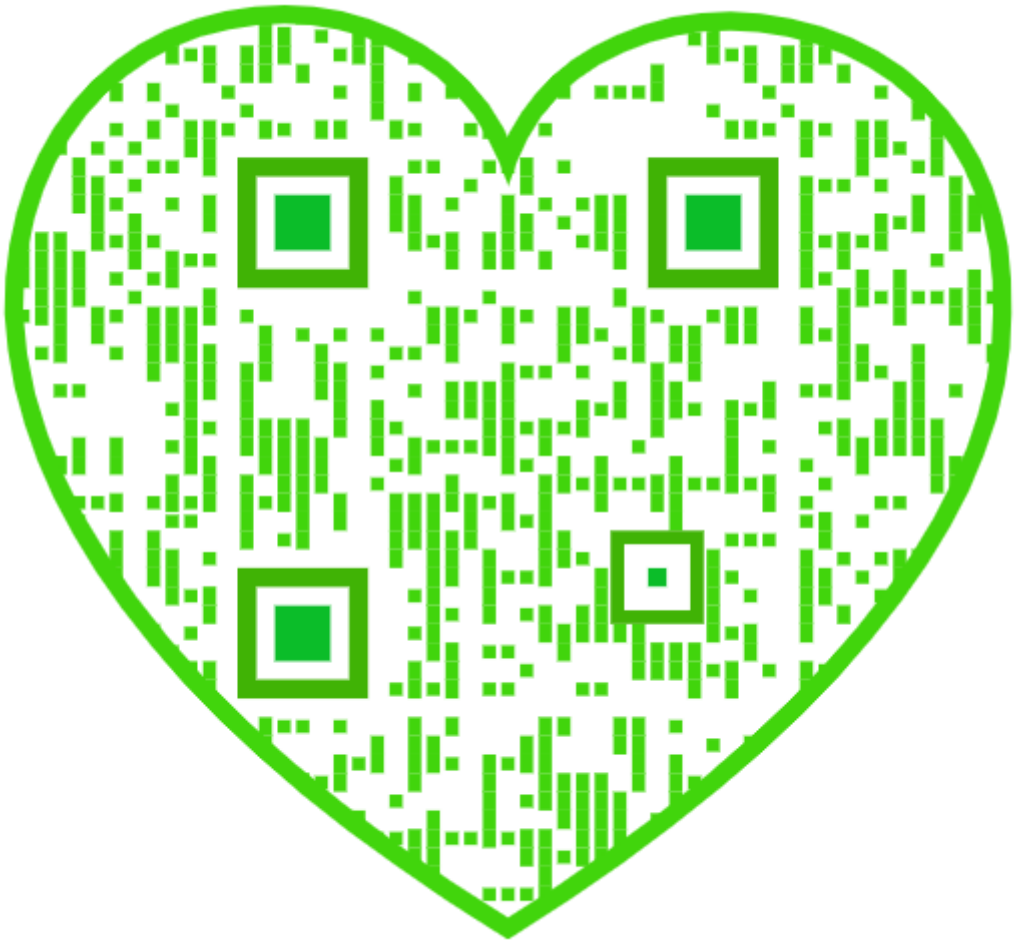

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INCREASE IN OUR ARTILLERY URGENTLY NEEDED.

It was only a few years ago that the country awoke to the fact that it was absolutely without modern sea coast defenses. To-day it finds itself in possession of a growing number of forts and guns, but has not sufficient trained gunners to man them. The successful agitation for the building of forts and guns may be said to date more particularly from the time of our trouble with Chile, when it was realized that the Pacific coast ports were defenseless against the cruisers of a fifth rate power. It resulted in the adoption of a system for the construction of modern defenses which provided for over 500 high power rifled guns of from 8 inches to 13 inches caliber, 1,000 twelve-inch mortars and 360 rapid fire guns, all of which were to be distributed among twenty-five of our most impor ant harbors. The defenses were also to include the placing of 6,000 submarine mines. By June of next year one-half of these guns and mortars, or over 900 separate pieces, are expected to be in place.

It now appears that although the work of reconstruction has been carried on with commendable zeal, no provision whatever has been made for manning the guns, and we are now at a stage where the question of an immediate increase in the artillery must be faced without delay. The problem is clearly set forth by Gen. George W. Wingate, president of the National Guard Association, in the current number of The Journal of the Military Service Institution of the United States.

Gen. Wingate insists that modern guns without gunners are as useless as guns without gun carriages, and that the calmness with which the present critical condition of affairs is borne by the nation is nothing less than wonderful. Our press and members of Congress are "fierce to resent the slightest infringement upon American rights," and we have "apparently cast off the restraint which diplomacy has imposed upon official communication between the representatives of civilized countries;" nevertheless, we leave our new defenses and high power guns without men enough to man them, as if they were a sort of "military scarecrows which would in themselves keep away an enemy as a farmer's old clothes frighten birds away from his grain."

There is a danger lest the present generation, in looking at the final triumphs of the civil war, should lose sight of the difficulties experienced at the outset in securing arms, officers or discipline. Hasty levies of patriotic citizens are at the first little better than armed mobs, and the necessity for preliminary training which was made clear in that war is trebly strong in these days of complicated long range ordnance. In working the modern gun, with its long range and high velocity, the gunner, during the heat of an action, when shells are bursting overhead, has to work out a problem which has to include the distance of the ship, the angle of approach, the speed, the strength of the wind and its direction, the temperature and the barometer. If he makes a mistake in any one factor of the equation, or, having solved it correctly, lays the gun with a variation of sight greater than one-fiftieth of an inch, his shot is wasted.

Good work of this kind can only be obtained from carefully trained men. It is granted that in time of war a proportion of the detachment of a heavy gun may consist of new enlistments, but the proportion of these cannot safely exceed three-quarters. All the gunners must be experienced and disciplined at the outset. When the new system of forts is completed 29,000 artillerists will be required to provide one relief for the guns. Three reliefs are required in war. The present fortifications around New York alone require 7,000 men to man them, and when all are completed the force necessary at this port will be 13,000. As the entire artillery force of the United States at present numbers only 3,890 men, including ten batteries of light artillery, it would not provide even half the number of men necessary to man the present fortifications of New York. As the system of defenses when completed will contain nearly 2,000 guns and mortars, the present force of artillerists would not provide two men to a gun. It is idle to think of having less than two skilled gunners to a gun to make it effective in time of war, and this would call for 4,000 skilled men. Army officers agree that not one-half of the present enlisted force of artillery is capable of becoming efficient gunners; so that to secure the 4,000 gunners would require an enlistment of at least 7,500 men.

It is not at present practicable to provide these forces from the National Guard of the States. What is needed, and needed at once, is a sufficient force of trained gunners, men who devote their entire time to their duties and are always in a state of high efficiency. It will be their duty to aid in "licking into shape" the additional artillerists enlisted in time of emergency. This force of 7,500 should be composed of men of a high grade of intelligence. If it is understood that this branch of the service is to be a select one, with good pay and comfortable quarters, there should be no difficulty in securing the enlistment of good mechanics, with sufficient technical training to render them competent to hold the position of officers and non-commissioned officers who would control the artillery force when expanded to a war footing. The training of this force should include a large amount of practice in target firing, and this could be carried out at moderate cost by fitting the large guns with auxiliary barrels of small caliber.

Although Gen. Wingate does not think it practicable to utilize our civilian soldiers in manning our heavy guns, he thinks that the government should encourage the National Guard to form field batteries, as the service of a light battery is acquired with much less difficulty than that of heavy artillery. The theory and practice can be obtained in the various armories. Government aid in the formation of such batteries has hitherto been absurdly inadequate; but if it would adopt the policy of lending to the States the guns and equipments, charging only for the perishable parts, the number of light batteries would be largely increased. One or more army officers should be detailed to each State to assist the National Guard officers in learning their duties, and a general invitation should be extended to the latter to undertake a brief course of practical instruction at the different army posts at which a regular battery is established.

The risks of war are as certain as any other risks to which a nation is exposed, and for New York the risk of bombardment, on account of the vast concentration of wealth and property, is doubly great. The Fire Department costs $1,500,000 a year and the city pays anually $6,000,000 in premiums against fire risk. Contrast this with the fact that the amount which the States are authorized to draw from the government for the militia is less than half a million, and it will be seen that the provision is absurdly inadequate. The estimate that $2,000,000 per annum represents the proper amount to be appropriated for military purposes is conservative and fully justified by the facts. Of this, one million should go to increase the sea coast artillery, one-half million for the benefit of the regular infantry force, and another half million for the benefit of the National Guard, particularly in increasing the field artillery and supplying it with ammunition for the regular practice, without which it would be of doubtful value.

REPORT OF THE INTERSTATE COMMERCE COMMISSION.

The Ninth Statistical Report of the Interstate Commerce Commission for the year ending June 30, 1896, has just been submitted. It is stated in the beginning of the report that there were 151 roads in the hands of receivers, a decrease of 18 on the previous year. The length of operated mileage represented was 30,475, a decrease of 7,380 on the total of the year before. The capital stock represented by these bankrupt roads was $742,597,698 and the funded debt was $999,733,766.

The total mileage was 182,776, an increase of 2,119 for the year. The largest increase, 233 miles, was in Georgia and the next largest, 202 miles, in California. The aggregate length, including all tracks, was 240,129 miles. The length of second track was 10,685 miles; of third track, 990 miles; of fourth track, 764 miles. The mileage of yard track and sidings alone was 44,912 miles.

The total number of locomotives in service was 35,950, an increase of 251 over the preceding year. The number of cars was 1,297,649, an increase of 27,088. The United States employ 20 locomotives and 713 cars per 100 miles of track, and each locomotive hauled on an average 51,471 passengers, the passenger miles accomplished per locomotive being 1,312,381. The work of each freight locomotive is represented by 37,634 tons and 4,684,210 ton miles.

This vast system employed 826,620 men, an increase of 41,586. Of these, 31,792 were employed in the general administration; 243,627 in maintenance of track and structures; 167,850 in the locomotive and car shops; and 373,747 in conducting transportation. The total amount paid out in wages and salaries was $468,824,531.

The amount of railway capital at the close of the year was $10,566,865,771, or $59,610 per mile. The funded debt was $5,340,338,502. The amount of stock paying no dividend was $3,667,503,194. The amount of funded debt which paid no interest was $860,559,442. The total amount of dividends was $87,603,371, which would be produced by an average of 5·62 per cent on the amount of stock on which some dividend was declared.

The number of passengers carried during the year was 511,772,737, an increase of 4,351,375 on the preceding year. The year was remarkable as witnessing the largest total of freight carried in the history of railroads in this country. It amounted to 765,891,385 tons, an increase of 69,130,214 tons over the previous year. The density of the freight traffic is shown by the number of tons of freight carried one mile per mile of line, which was 523,831, an increase of 44,342 ton miles per mile of line.

The gross earnings for the year were $1,150,169,376, an increase of $74,797,914. This was made up mainly as follows: Passenger revenue, $266,562,533; carriage of mails, $32,379,819; express matter, $24,880,383; freight revenue, $786,615,837. The passenger revenue showed an increase of over 14 millions and the freight revenue of over 56 millions. The operation expenses were $772,989,044, an increase of over 47 millions on the year.

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These expenses were assigned as follows: Maintenance of way and structures, 160 millions; conducting transportation, 440 millions; maintenance of equipment, 133 millions; general expenses, 36 millions.

The income from operation, that is, the gross earnings, after deducting operating expenses, was over 377 millions, an increase of over 27 millions. The income from other sources, chiefly leases and investments, was 129 millions, making a total income of 506 million dollars for the year. The total deductions from income were $416,573,137, so that the net income out of which dividends and surplus were declared was $89,631,926. This amount is 33 millions of dollars larger than the corresponding one for the previous year. The dividends declared were $87,603,371.

The statistics show that the slaughter of railway employés continues with ghastly activity, the number of killed being 1,861, an increase of 50, and the number of wounded being 29,969, an increase of 4,273—and yet forsooth the railways are asking to be excused from equipping their trains with safety appliances. The number of passengers killed was 181, and 2,873 were injured, an increase of 11 killed and 498 injured. The number of persons other than employés and passengers killed was 4,406, and the number injured was 5,845; these figures include casualties to persons reported as trespassers, of whom 3,811 were killed and 4,468 were injured. The number of passengers carried for one passenger killed was 2,827,473, and one passenger out of 178,132 was injured. The immunity of passengers from accident is shown by the ratios based upon the number of miles traveled, from which it appears that 72,093,963 passenger-miles were traveled for every passenger killed, and 4,541,945 passenger-miles for every passenger injured. This is a satisfactory showing, and contrasts sharply with the terrible fatalities among employés, where one man out of every 444 was killed, and one man out of every 28 was injured. The figures for trainmen are still more shocking, for of these, 1 man out of every 152 was killed, and 1 out of every 10 was injured! If the commission will merely quote these shocking figures to the wealthy corporations that are just now pestering them to extend the time set for equipping the cars with couplers and train brakes, they will surely have given a sufficient answer and rebuke.

THE SEVENTH INTERNATIONAL GEOLOGICAL CONGRESS - THE CAUCASUS EXCURSION.

BY E. O. HOVEY, PH.D.

In the minds of most of the members of the congress the geological excursion to the Ural Mountains before the sessions at St. Petersburg and to the Caucasus region afterward formed an integral and very important part of the whole, for by means of these excursions geologists from all over the world have been enabled to obtain a very good general idea of a great region which is usually very difficult of access for travelers. When the sessions of the congress in St. Petersburg closed some two hundred of those who had been in attendance went to Moscow to take part in the excursion to the southern part of the empire. Three days were devoted to studying the geology in and near Moscow; the hill on which the Kremlin stands, the Sparrow Hills (from which Napoleon watched the entrance of his army into Moscow) and Miatchkowo, a place noted for its Carboniferous fossils, being the localities visited.

From Moscow the geologists went southward in three parties by routes offering different points of attraction. One section went by way of Nijni Novgorod, and down the Volga River by steamer to Tzaritsyn or Astrakhan and Petrovsk and thence by rail to Wladikavkaz. This party had an interesting view of the geological section from Carboniferous to lower Tertiary along the right bank of the river, as well as of the phenomena of the great river itself and of the ethnological features shown by settlements along it. Another party went to Kiew and through the Dnieper valley to Kherson, traversing a region of special interest to students of Tertiary strata. The third and largest section visited Kharkow and the Donetz basin, and went thence to Wladikavkaz. This last group saw more mines and traversed a region more varied geologically than either of the others and will therefore receive the most detailed description in this account.

After leaving Moscow the first stop was made September 10, at Podolsk, to examine the great quarries of the cement works located there. The strata worked are of upper Carboniferous age, covered by about ten feet of morainic clay, and are put to various uses. The clay furnishes the red bricks which are the principal material of construction used in Moscow, and a heavy bed of fossiliferous yellow lime, capable of high polish, is used for stairways and ornamental purposes.

Some of the horizons consist of almost pure carbonate of lime, which, mixed in certain proportions with the clay, produces a Portland cement, while the dolomitic (magnesian) marly layers are mixed with the clay for the production of a Roman cement.

After leaving Podolsk, a few hours were spent in the important manufacturing city of Toula, and the party went, on the same afternoon, to the Petrovskoïe coal mines, about ten miles from Alexsine.

Three beds of coal, which occur in the lower part of the lower Carboniferous series, are exploited here, and some beds of pure quartz sand, also of lower Carboniferous age, are about to be used in a glass factory, now in process of construction near by.

This was the last place in the Moscow basin visited by the party, which then proceeded to Kharkow, where the study of the Donetz basin was begun in the geological museum of the university. Magnificent banquets were tendered the excursionists by the university and the city, which were but two of the series of fifteen banquets given this group of geologists while on their way from Moscow to the mountains. While these banquets were an expression of the unbounded welcome given the foreigners by all classes of Russians, they did not greatly assist in the study of the geology of the region. Between forty and fifty general banquets were tendered the geologists during their stay in Russia.

Kharkow is one of the most important cities of southwestern or "Little" Russia, and contains a university, a technological institute and two high schools.

Two days were spent in studying the coal fields of the Donetz basin and a mercury and a salt mine located in the same region. The Carboniferous rocks of this basin are divided provisionally by Messrs. Tschernychew and Loutougin, of the Geological Survey, into a lower, a middle and an upper section, the workable beds of coal lying in the middle section and the lower part of the upper section, the best being in the upper part of the middle series. The basin of the Donetz bears much closer analogy to the coal-bearing area of our central west (Iowa, Missouri and Illinois) than it does to the areas of western Europe, according to the Russian geologists. The Paleozoic section of the Donetz presents a complete series from the Devonian through the Permian into beds of indubitable Jurassic age, and in addition to the mines of coal, mercury and salt already mentioned, the rocks contain deposits of gold, silver, zinc, lead and iron which are being exploited.

The coal industry is by far the most important, there being about 10,000 square miles of exposed coal-bearing strata and a still larger area which is covered by later deposits. The geologists examined the Carboniferous section near the stations of Wolyntsewo, Gorlovka, Almaznaia and Warwaropol and the upper works of some of the coal companies. Gas and coke coals and some anthracite are produced. The best beds of gas and coke coals are in highly inclined strata, but those which are nearest the axis of the main anticlinal contain the lowest percentage of volatile constituents and grade into anthracite.

The veins of cinnabar (sulphide of mercury) were discovered in 1879 by A. Minenkow, a mining engineer. They are situated near Nikitovka and are in the zone of the main anticlinal just mentioned. Those which are actually exploited occur in three minor folds. The most important is known as the "Sophia." The belt extends in an east-west direction and the veins end within the tract of land owned by the company. The ore occurs in the joints and crevices of a gray quartzite and impregnating a sandstone. Where the rock has been slickensided the cinnabar also is often seen to have been polished by the friction. A noteworthy association is the occurrence of irregularly disposed seams of coal or carbonaceous material together with and even inclosing cinnabar. The Russian geologists hold that the carbon has acted as a concentrator of the mineral. The cinnabar occurs in crystals and in massive form. The chief associated mineral is stibnite (sulphide of antimony), but pyrite occurs in some of the nearby strata. The present prosperous condition of the mine is due to the skill of Mr. A. Auerbach, of the firm of Auerbach & Company, who took the property a few years ago, when it was almost bankrupt. Last year the product of the works was 20,000 flasks of refined quicksilver, and this year it will be still greater.

The last mine visited in the Donetz basin was the great salt mine at Dekonskaïa, near Bakhmout. The upper Permian strata of the Donetz are composed of clay, red and green marls and friable sandstones, to which are subordinated gypsum, anhydrite and rock salt. The series corresponds, in part at least, to the lower red beds of the Permian of eastern Russia. In the Donetz basin the Permian beds occur only in the western part, where they border the principal area of Carboniferous beds or emerge in isolated islands from beneath more recent rocks. For many years salt has been produced at Bakhmout by evaporating brines, but it was not until 1874 that the rich beds of rock salt at Detonskaïa were discovered in a boring put down according to the suggestions of two Russian geologists, Messrs. Karpinsky and Erofeïew. Between the depths of 255 feet and 765 feet (the bottom) nine beds of rock salt with a total thickness of about 340 feet were pierced. The level visited by the party of geologists is about 500 feet below the surface. The mine consists of vast chambers cut in Nos. 26 and 27 of the bore section. The combined thickness of these two beds is more than 123 feet, the upper six feet of which is interstratified with gypsum. The salt usually presents the appearance of a granular white mass, but one often meets with large nests of perfectly transparent crystals and there are many cavities containing mother liquor. The salt is extracted by blasting, and the arched chambers thus left are impressive on account of their size and height and beautiful with their glistening white walls lighted up with the electric lamp as usual, or illuminated with red and green fire, as was done for the benefit of the geologists. Active mining here was begun sixteen years ago, but the development of the industry has been so rapid that the present annual production exceeds 16,000,000 pounds (262,000 metric tons).

After leaving the Donetz basin the route lay across the broad flat plains surrounding the Sea of Azov to the northwestern foot hills of the Caucasus range, where most of the party visited the warm and cold mineral springs at and near Piatigiorsk and Kislowodsk. The waters are sulphurous and carbonated and have great reputation among the Russians, who have made a health and pleasure resort of the region. A small number of geologists who were specially interested in petroleum went to see the oil wells at Grozny instead of visiting the mineral water region, and another small section were left behind at Kislowodsk to make an excursion into the region near Mount Elbrus.

The drive over the famous Georgian military road from Wladikavkaz to Tiflis was inspiring on account of the wild grandeur of the mountain scenery and interesting to geologists, especially the petrographers, on account of the igneous rocks which were encountered during the first half of the ride. On the southern side of the mountains the road led for miles along the side of a canyon-like valley, the depth of which was more than 4,000 feet.

From Tiflis side excursions were made to the mineral springs at Borjoom, the Tertiary coal mines of Tkwibouli, and the monastery of Ghelati by some of the geologists, while the managers were waiting for all to come over the mountains. Then two days were spent in the Baku oil region on the Caspian Sea. So much has been written about this region that the readers of the SCIENTIFIC AMERICAN will not care for a detailed description of it here. The refineries of the Nobel Brothers and the wells at Bibi-Eibat, Balakhany, and Sourakhany were the objective points of the visit of the excursionists. Much of the oil is still lost by evaporation from the open reservoirs into which many of the wells discharge.

On leaving Baku the great body of the geologists went directly to Batoum and there took a special steamship for the Crimea, where about a week was spent in examining the volcanoes, volcanic rocks, and sedimentary deposits of that historic peninsula from Kertch to Sebastopol. The official close of the grand excursion took place at the latter city on October 5, and at Odessa the geologists scattered to their respective homes. A party of about thirty-five separated themselves from the rest at Baku, and, leaving the railroad at Akstafa, took carriages for a side trip into Armenia, the ascent of Mount Ararat being the main object of the excursion for most of the participants. After leaving the broad plain of the Kura River, the road traverses a short section of Cretaceous and then enters the great fields of lava, which cover an immense area in Russian Armenia and stretch to undetermined distances in Persia and Turkey. The literature on the region is very scanty. The drive of one hundred and twenty miles to Erivan was made in two days of hard work, but many items of interest to petrographers were picked up en route, while the scenery is very fine. At Erivan the party divided up somewhat, twenty-eight going on to Ararat and the others disposing of themselves in various ways.

The Ararats are great volcanic cones which have suffered much from erosion. Augite-andesite constitutes the mass of Little Ararat and most of Great Ararat, but basalt occurs on the northwestern flank of the latter. The snow cap prevents the determination of the existence of a summit crater on Great Ararat, but there was such a crater on Little Ararat. Neither cone presents any great mountaineering difficulties to an ascent; success is a question of endurance, perseverance, and proper preparation.

Before going to the mountain the party spent a day in visiting Etchmiadzin, the headquarters of the orthodox Armenian church; and after returning from Ararat the journey led over the lava-strewn plain at the base of Mount Alighenz to Alexandropol and out to Ani, the ruined capital of ancient Armenia, which stands on a bluff made up of a series of beds of interesting volcanic tuffs. From Alexandropol the party returned to Dilijan over a part of the route of the Kara-Tiflis Railway now building, and thence to Akstafa, where the train was taken for Batoum, and the Ararat party followed their predecessors to the Crimea and out of Russia, sorry to leave a country where they had met only friendship and unbounded hospitality from everyone, from the Czar to the meanest peasant, for nearly three months, and had learned much of great geological interest, while viewing beautiful scenery and seeing some of the many different tribes and nations that constitute the Russian empire.

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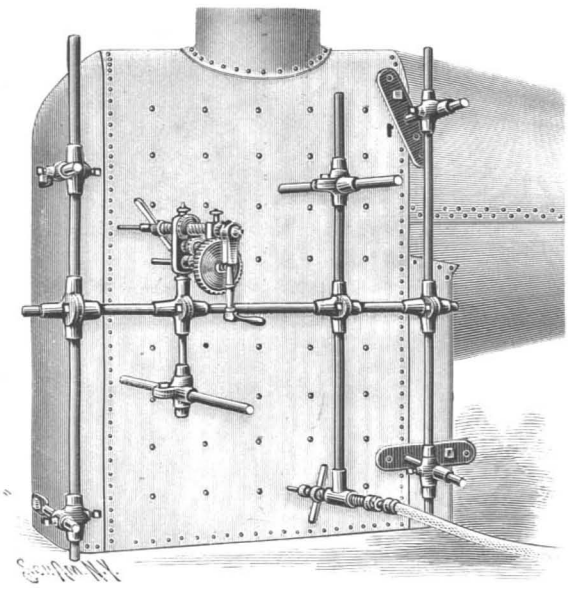
AN IMPROVED DRILL.

The illustration represents a drill especially adapted for making the rivet holes in boilers, drilling out rivets or stay bolts, and other similar work, and in which the drilling device may be pneumatically or hydraulically operated, or operated by a flexible shaft, and in which the feed will be automatic or may be manually effected. The improvement has been patented by William J. Hatton, of Escanaba, Mich. Two uprights are employed, mounted in sockets, the sockets of one upright being adjustably connected with tie plates screwed or bolted to the boiler near one edge, while arms are adjustably attached to the sockets of the other upright, the arms having longitudinal openings through which bolts are passed into a side of the boiler, whereby the uprights may be held the desired distance from the surface to be drilled. Adapted to be moved up and down and adjustably secured on the uprights are sleeves or sockets which support the ends of a cross rod on which is an adjustable sleeve carrying a standard, there being at the lower end of the standard an adjustable socket in which is a pin to engage the surface of the article to be drilled, holding the drill in the desired position. The upper end of the standard is enlarged to form a bearing surface for a ratchet drilling mechanism, by which, as the ratchet arm is revolved, the drill is turned, a feed shaft moving the drill forward as the drilling continues. If at any time the automatic feed is not required, or a further feed is desired either backward or forward, such movement is effected by turning a hand wheel. In the lower portion of the engraving a slightly modified form of the device is shown, with the drill being operated by a flexible shaft, it being apparent that the drilling mechanism may be conveniently carried to any desired point on the boiler or the article to be drilled.



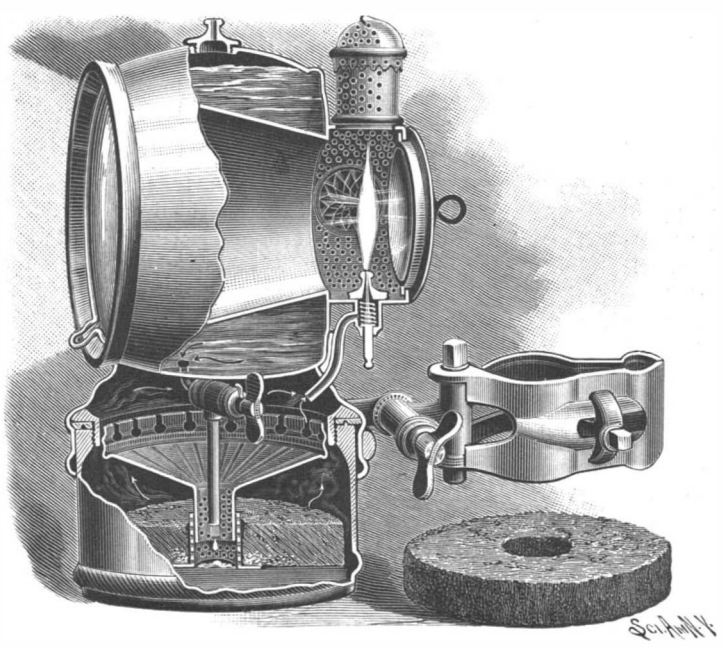
HATTON'S DRILL.

AN ACETYLENE GAS LAMP FOR BICYCLES.

Everyone who has seen acetylene gas burned under favorable circumstances will concede that no more perfect light was ever produced. It is clear, penetrating, steady, with an efficiency incomparably greater than can be obtained from any method of burning gas, and equal if not superior to that obtained from the electric arc, but without the unsteadiness of the latter. Ever since its possibilities began to be understood by the public, some five years ago, it has been earnestly hoped that the methods of production of the calcium carbide, and the means for burning the acetylene gas made therefrom by the simple addition of water, might be so perfected, and the cost made so reasonable, that this light would come into general use.

In the accompanying illustration we represent an acetylene gas lamp for bicycles, which is the result of some years of trial and experiment, and which seems to present many points of excellence—including the primary one of affording a brilliant and beautiful light, while also being entirely safe in use. This new lamp is being manufactured and put upon the market by the George H. Clowes Manufacturing Company, of No. 464 Bank Street, Waterbury, Conn. The gas is made from the carbide, as will be remembered, by the supply of water in just sufficient quantities, and for this purpose the outer portion of the cylindrical body of the lamp, in the front of which is the reflector, consists of a water chamber, to be filled through a cap-closed opening at the top, the valved outlet at the bottom of the water chamber being at the time closed by a thumb piece. The supply of water to the carbide is afterward effected by the adjustment of this valve, which at first is opened only about a quarter turn, but is afterward preferably regulated to produce a flame about an inch in height.

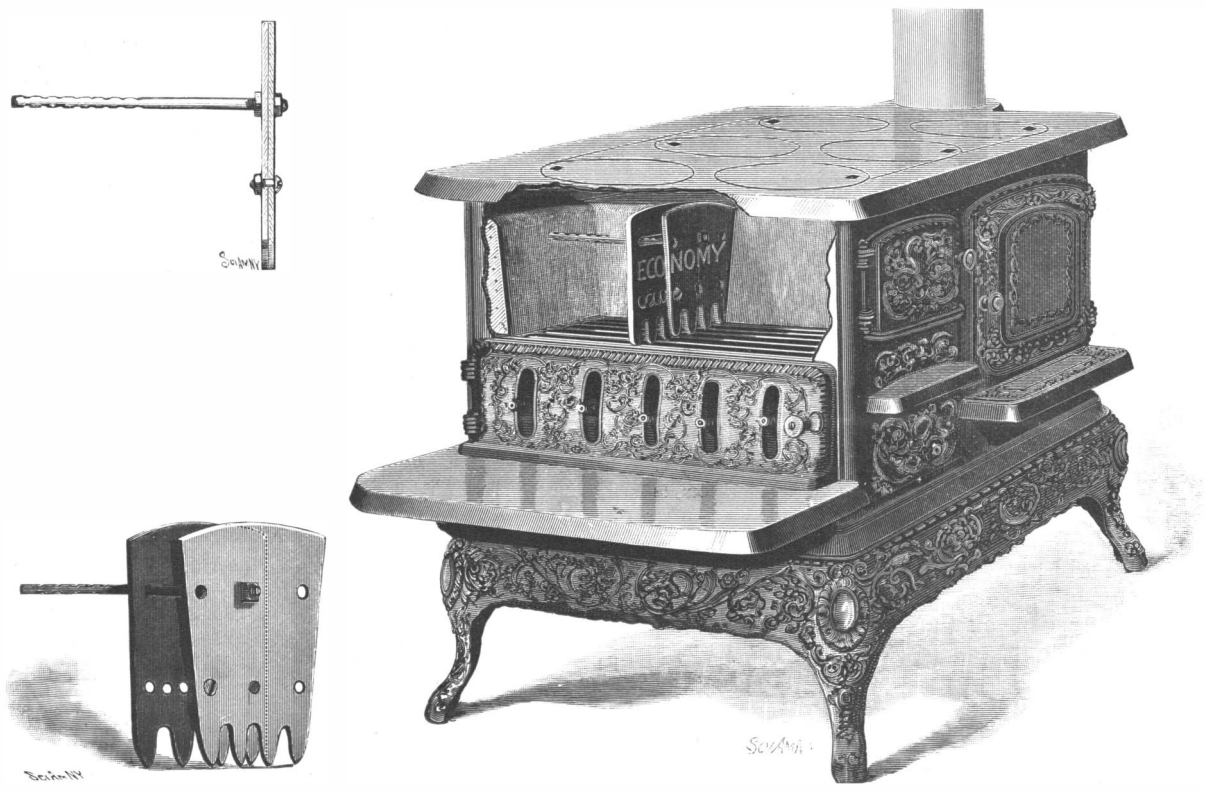
The water is fed down through a tubular feed of peculiar construction in approximately a drop by drop movement into a metal cup with perforated sides, and in the portion of the lamp surrounding this cup is placed a centrally perforated disk or cake formed of crushed calcium carbide, united with a mixture designed to keep the carbide from deteriorating, and remove the peculiar odor of exposed carbide. These charges, made into cakes, are styled carbophene, and are designed to be more easily handled and give a more satisfactory light than the raw carbide. These cakes, one of which is represented in the small figure, are furnished packed in air-tight boxes, two different sized cakes in each box, and six of these boxes are placed in an air-tight cylinder, to insure that the carbophene shall always be in good condition for use. These cakes are respectively one and one and a half ounces each, costing thirty cents a case (two cakes in a box and six boxes in a case). Each ounce cake is designed to afford from three to six hours light. A few seconds after the supply of water is turned on the gas produced fills the space above the carbide, and the burner may be lighted at the top of the chimney cap or by taking off the reflector. The water feed is increased as the charge becomes exhausted, and the jolting of the lamp in rough riding increases the generation of gas, causing a higher flame. The lamp is conveniently attached to the fork of the machine by an improved form of adjustable bracket, by means of which the light may be readily thrown in any desired direction. Each burner is provided with a needle-pointed cleaner, with downwardly extending stem, by pushing upon which the point enters the orifice of the burner, the cleaner being then automatically withdrawn by a spring. As the gas is burned at a low pressure, and the burner hole is very small, this device affords ready means for keeping the burner always clear. The lamp, it is claimed, cannot explode, because the water valve, when entirely open, would not supply sufficient water to generate enough gas to effect an explosion. It is of handsome construction, easily charged, and, as there is no smoke, soot oil or disagreeable odor, the lamp can be kept clean with a white pocket handkerchief without soiling it.



AN ACETYLENE GAS LAMP FOR BICYCLES.

AN ADJUSTABLE FIRE BOX PARTITION.

The accompanying illustrations represent an improvement which has been patented in the United States and all foreign countries, and which is designed to effect great economy in the consumption of fuel, while affording more complete combustion, it being possible with this readily applied device to reduce or increase the area of the fire in proportion to the amount of work to be accomplished. The device is the invention of W. G. Hamilton (deceased), of Colorado Springs, Col., and it is being introduced to the public by Carleton Gilbert (P. O. Box 2490), New York City. Of the two plates lying side by side and forming the partition, adjustably held in the fire box, as shown in the larger view, one is wider at the top than at the bottom, and has two horizontal rows of perforations, while the other has parallel vertical edges, an elongated horizontal opening near the top, and a lower row of perforations. After adjusting the plates to the width of the fire box, they are made fast in such position by a stove bolt passed through any two of the perforations of the lower rows, and a nut, as more plainly shown in the two small figures. To adjust the partition at the desired distance from one end of the fire box a rod is employed, threaded at one end and notched at regular intervals at the other end, to facilitate breaking off and thus shortening the rod as desired. This rod, with nut screwed on the end of its threaded portion, is passed through the elongated opening in one plate and any one of the upper perforations in the other plate, and a nut is screwed on the outer end, securing the rod in position and forming an additional clamp to hold the plates together. The word "Economy" faces the end of the fire box which contains the fire, the notched end of the rod extending in the opposite direction engaging the end of the fire box, and preventing the partition from tipping over in that direction, the fuel holding it in place on the other side. In ordinary use the partition will probably be placed at about the middle of the fire box. The lower edges of the plates terminate in teeth, which are notched to facilitate breaking them off, as may be necessary when, in adjusting the partition in the fire box of a stove or range, the teeth of one plate come between those of the other, thus obstructing the draught space which the openings between the teeth are designed to provide. It thus may be necessary to break off all except the outer teeth, and, should the bottom of the fire box be lower at the center than at the outer edge, the outer teeth are broken off on each side, to make the partition properly fit the bottom. The partition, after having once been properly fitted in the fire box of any stove or range, may, without further adjustment, be readily taken out or replaced, and this may be done even when the fire is burning, in the case of placing the partition when the fire is burning it being supposed that the fire is low enough to enable the coals to be pushed to one end, while, when the partition is removed to obtain a larger fire, the burning coals are quickly spread over the grate. The improvement, aside from the economy thus effected, presents especial advantages when one requires only a small fire, as is so frequently the case in warm weather.



THE "ECONOMY" ADJUSTABLE FIRE BOX PARTITION FOR STOVES AND RANGES.

THE American Ornithologists' Union holds its 15th annual congress in New York on the 9th, 10th and 11th of November. The total number of active and associate members on its rolls is nearly 1,000, including almost every ornithologist of special note in the world.

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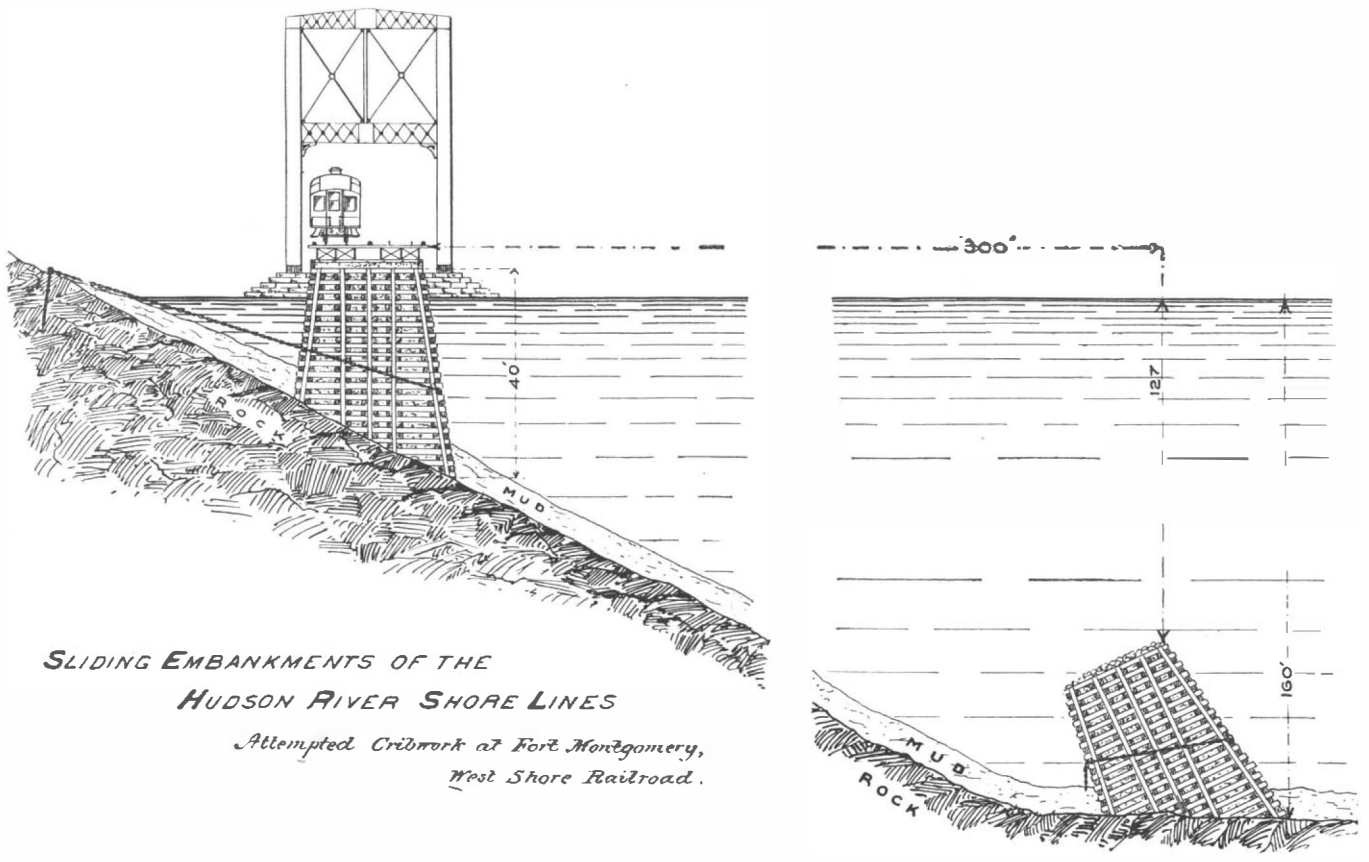
THE SLIDING EMBANKMENTS OF THE HUDSON RIVER SHORE LINES.

BY ARCHIBALD A. SCHENCK, MEM. A.S.C.E.

The recent loss of a train of the New York Central Railroad, north of Highlands, has drawn the attention of the traveling public to the river embankments of the two roads running along the Hudson River shore lines, the New York Central Road on the east shore and the West Shore Road on the west shore. Everything below the surface of the water being invisible, the imagination is given full play, and every embankment between New York City and Albany is likely to be the subject of uneasy inquiry by the poorly informed traveler.

There is very little of the line of either road that comes near the deep water, and where it does so, the places demanding especial care are few in number. It is, of course, vital that these few should receive careful attention.



SLIDING EMBANKMENTS OF THE HUDSON RIVER SHORE LINES

Attempted Cribwork at Fort Montgomery, West Shore Railroad.

The two conditions that create dangerous embankments, namely, a deep channel and its close proximity to a rocky shore line, exist chiefly through the Highlands, from Peekskill on the south to Cornwall on the north. There is only one portion of the Hudson shore line outside of the Highlands where a deep channel bears closely against a rocky shore and affects railway construction. This extends along the west shore from a point about opposite New Hamburg to a point a short distance north of Poughkeepsie. North of this place and south of Peekskill the channel bears against mud flats of ample extent for safety wherever the railways are close to the river. The writer is not familiar, from personal examination, with the West Shore line north of New Hamburg, except as he visited it twice during construction of the West Shore Road.

The first "deep hole" encountered by the West Shore Road, running southward from Cornwall, is at Storm King. The next is at Rose's, opposite Cold Spring, some distance north of "Target Hill." The third is just south of West Point dock. The fourth is at Cranston's. The fifth is south of Fort Montgomery, between Negro Creek and Popolopen Creek. The investigations made during construction of the West Shore Road were probably unequaled in any railway construction as to expenditure both of time and money for engineering service. A hydrographic party was employed for many months under the writer's direction, with a special assistant and engineer force, and a capable boat's crew. The examinations included not merely soundings to determine the slope of the bottom, but numerous borings with rods at great depths, to determine the slope of the solid rock surface underlying the sediment of the river bottom. Wherever in the original location the line had been placed too far out and the rock embankment (no other material being used at the deep holes) had slid out, its course and location after the slide were traced and noted upon the charts and sections.

At the first deep hole, at Storm King, the line was moved in upon the solid rock at enormous expense, giving an immense depth of cutting on the upper side.

At deep hole No. 2, at Rose's, a similar treatment was given to the trouble, but the rock not being so high, the construction work is not so apparent.

At deep hole No. 3, south of West Point dock, the deep water ran parallel with a long straight cliff, instead of surrounding a rounding point, as at Rose's and Storm King, and it was finally decided to cut a ledge upon the solid rock along the whole extent of this cliff and place the line upon a solid basis, although this involved great waste of excavated rock, which could not be taken endwise and utilized.

Deep hole No. 4, at Cranston's, was an exceedingly difficult place. The cliffs are very high and steep; the channel was very close and deep, bearing in against this cliff formation sharply. It was a triple difficulty. North of the northerly or highest cliff the line was moved in until part of the roadway was on the original ground out of water, and the rock filling was massed at this point, being carried northward from the rock cut. Great care was taken to have the excavated rock go northward into the deep hole, instead of having it blown sidewise into the river and wasted. Special inspectors of rock were appointed to see that this was done.

On the other two portions of this deep hole, No. 4, substantial bridge spans were introduced, although the solid rock had to be cut out at the inner corners of the spans in some places to admit of their erection. These spans can be seen from the opposite shore. Many travelers on the New York Central Road wonder why they are there.

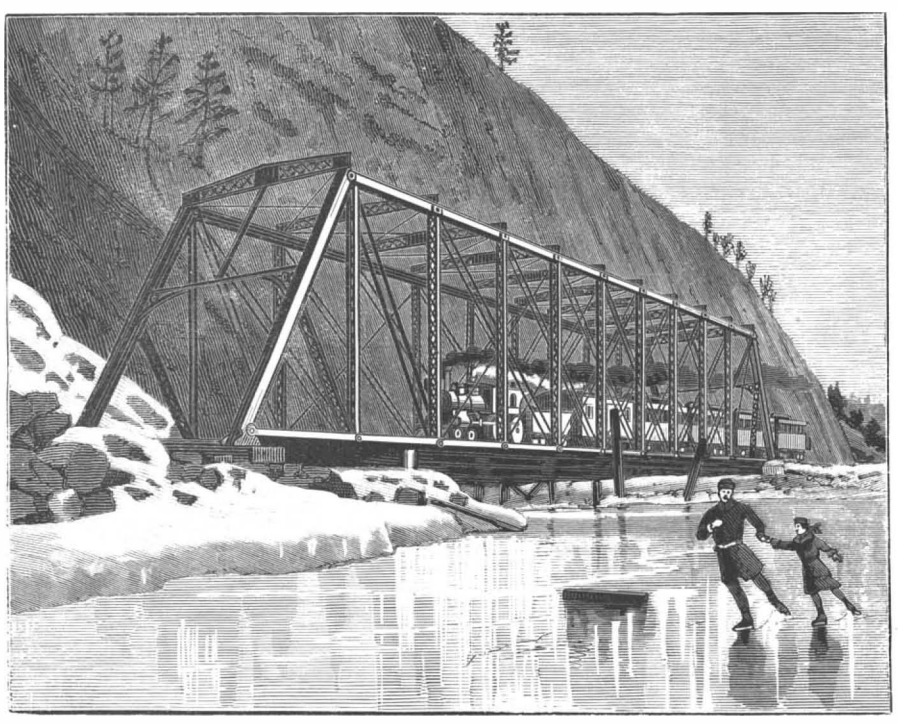
Deep hole No. 5, at Fort Montgomery, is a double hole, lying on each side of a large rock cut. North of the cut, the deep hole was "fought," as at Cranston's. The writer's judgment was in favor of a span here, but no north abutment could be secured except at very great expense for underwater foundations, the rock filling already put in making such work doubly difficult.

A very sharp swing inward was therefore given the line, a swing that travelers would object to less if the increased safety were fully understood. South of the rock cut a very heavy two-truss span was built.

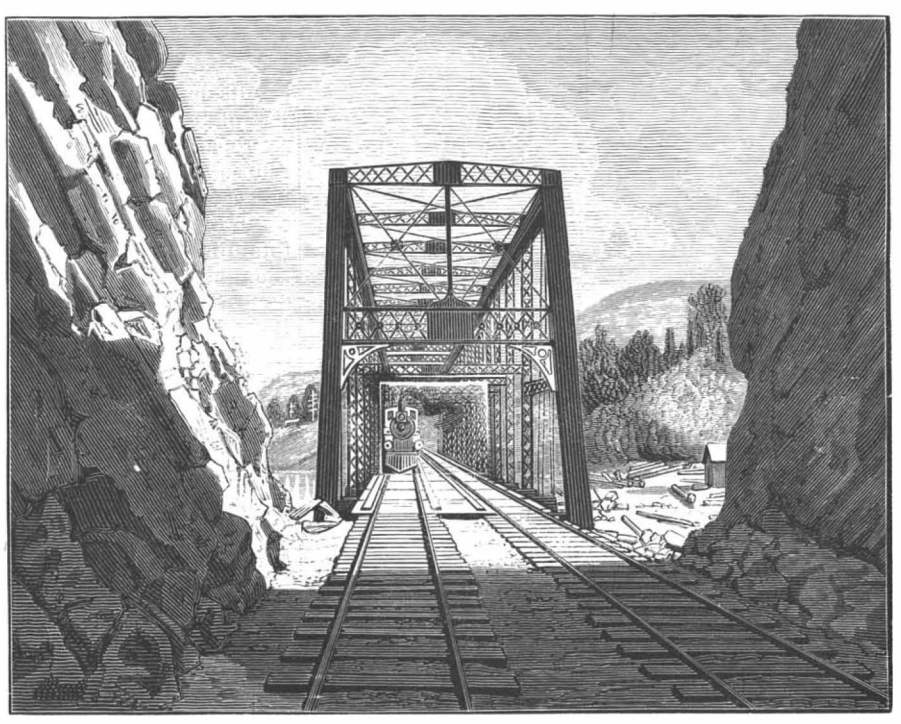
At first the attempt was made to "fight" this hole. Repeatedly the rock filling was made almost across the bight, and repeatedly it went out "like a shot." Then a crib was attempted. It was completed, heavily anchored to the rock inshore by five enormous chains and by anchors running vertically down several feet into the rock. It, too, went out and slid into 160 feet of water, at a distance of 300 feet from shore. The traveler need have no uneasiness about this most difficult deep hole. The train carries him over it on a steel span of ample strength, resting on abutments cut out of the solid rocks along their entire width.

Looking across to the east shore, we note that in general where the difficulties exist on the west shore, the east shore is safe with ample bermes and easy underwater slopes. There are no records extant as to what examinations were made when the present railway was constructed, or what the engineers in charge knew of the conditions, but the alignment of the railway shows that they were wide awake to the difficulties at these three places. At each of them the line was swung abruptly inward.

The indications of the underwater difficulties on the east shore are few, and appear to bring down to a very small figure the number of places that appear to have given uneasiness in the original construction. They also show that the engineers on the original construction of the New York Central Road were keenly alive to the work of avoiding dangerous construction. Wherever there is any marked and unusual deviation



BRIDGE BELOW COZZENS' HOTEL—SPAN 200 FEET.



BRIDGE AT FORT MONTGOMERY—SPAN 290 FEET.

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from a normal location of the line of road, we can find some good reason for it.

The construction aimed at on the West Shore Road at the deep holes was rock fill of sharp rock from the excavations. This construction has three advantages over a protected earth filling: 1. The sharp rock, by its sharpness and weight, gets a grip of the mud bottom, and the mud slope, however much lubricated by the water, has little or no effect as a smooth surface in sliding the mass out into the river. Where rock fills went out during construction, it was generally, as nearly as could be ascertained, because of the mud layer in which the rock fill had obtained a grip being too weak to sustain the increasing weight. The rock fill did not so much slide on the top of the mud as did both rock fill and mud layer upon the underlying rock.

2. The rock fill requires no protective wall. It is stable in itself and cannot be overthrown or eaten away by the water.

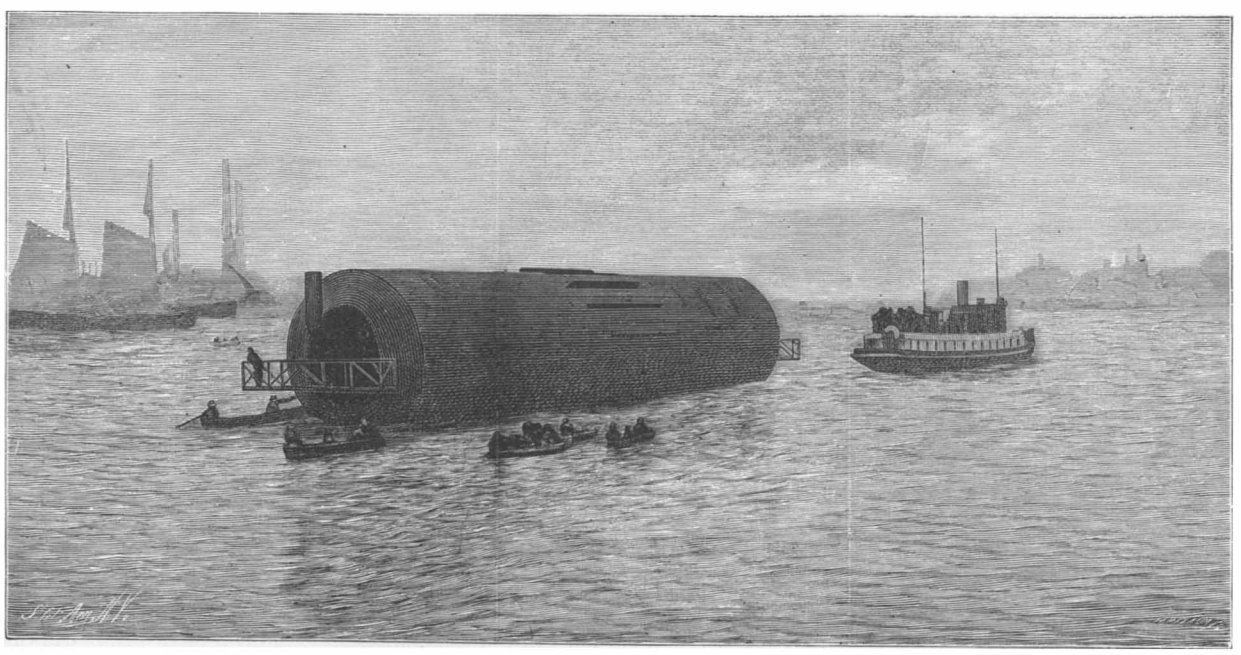
3. The interstices are in time gradually filled by the river deposits, and the whole cemented together into one mass. A rock fill grows more stable with age.

Where such a fill cannot be carried by the underlying mud slope, this is shown promptly during construction. With each month that it remains in place, it settles more into the mud, because more cemented together, and increases in staying power.

The writer's object has been to show the limited extent and number of the difficult places. It is for the company and not the writer to define the cause or causes of the accident at Highlands, so far as the original construction and location are concerned. A test of nearly half a century with ordinary conditions, and of half a dozen years with modern heavy trains, would seem to be almost a final test.

THE LATEST ROLLER BOAT.

It is difficult to account for the inspiration which has led such men as M. Bazin in France and Mr. Knapp in Canada to attempt to make vessels travel a rolling, instead of a gliding, motion. Wherever the inspiration may have come from, its results, so far, have not been encouraging. The Bazin boat picked up the water with its wheels and sunk itself to the hubs with a persistence which looked like an indignant protest against the attempt to take a ship from its native element and make it move over, instead of through, the sea. The water clung so tenaciously to the wheels that they failed altogether to rotate with speed commensurate with the odd twenty or thirty knots an hour which had been freely predicted; and when, in despair, the inventor placed more powerful motive power in the boat, she sank so deeply as to put record-breaking speed out of the question.



THE TRIAL TRIP OF THE KNAPP ROLLER BOAT.

Though the Bazin boat was a failure, it did not deter Mr. Knapp from a costly experiment in the same direction. In looking at his boat, as shown in the accompanying illustration, it must be admitted that, while the roller boat idea was old, the present application of it is decidedly novel.

Mr. Knapp abandoned the idea of making the wheels separate from the boat, if such it could be called, and formed the boat and wheels in one; so that the boat may be said to do its own rolling.

The vessel consists of a huge cylinder 22 feet in diameter and 110 feet long, the ends tapering somewhat suddenly to a diameter of 15 feet. The ends are open and through them admission is gained to the interior of the "ship." At each end of the cylinder is laid a series of steel tracks, which extend in a complete circle entirely round the shell to which they are firmly bolted. Upon each set of tracks is mounted a platform, the platform being carried on flanged wheels, which enable it to maintain a level position during the rotation of the outer shell. On each platform is located a separate boiler and engines, the engines being geared to the supporting wheels. The smokestacks will be noticed protruding from the ends of the cylinder.

Now it will be seen from the foregoing description that, if the cylinder were held stationary, the engine platforms would revolve. On the other hand, if the platforms are stationary, the cylinder will revolve. When the engines are started, the platforms begin to climb the inside of the shell, and the shell being free to revolve, the platforms roll the shell around beneath their wheels. On the outside of the shell are bolted 16 paddles or floats, 15 feet long and 8 inches deep, which are not placed radially to the cylinder, but are slanted so as to hold the water and drive the cylinder forward over the sea.

The boat carries two large tail boards, or rudders, which are located one on each side below the platforms.

The trial trip was made on October 21 at Toronto, where the boat had been constructed, at Polson's shipyard. Our illustration shows the marine curiosity as it was being towed out to the trial course. When the engines were started, the inventor and builder, who elected to watch the experiment from the deck of a ship of normal construction, had the satisfaction of seeing the cylinder make six revolutions a minute, and slowly forge ahead over the water. The speed was six miles per hour, and though the boat rolled, its trials did not give any reason to expect that the marine greyhounds of the future will move over instead of through the sea.

Science Notes.

Prof. J. A. Brashear has just completed the second photochronograph, which he has made for the government, for testing the velocity of cannon balls. The new apparatus has many improvements over the old one and has met all the expectations of the government experts. But one lever is used to fire the gun, start the tuning fork to vibrate, open the main shutter, and release the electric connections which throw a beam of light on the photographic plate, which rotates 1,500 revolutions per minute.

M. Porché has recently submitted to the Paris Academy of Sciences a method of overcoming the difficulty of keeping the subject still while taking a radiograph. He proposes to use a fluorescent screen, and, instead of taking a radiograph directly on the plate, to photograph the shadow on the screen. An extremely sensitive plate is required, and this plate must be protected from all other rays emanating from the Crookes tube except those which actuate the fluorescent screen. The results depend essentially on the rapidity of the sensitive plate.

Preparations are being made to observe the total eclipse of the sun on January 22, 1898, which will be best seen in India, says The English Mechanic. On the coast, in the vicinity of Bombay, the duration of the total phase will be a little more than two minutes, and the time available for observations decreases to a hundred seconds as the central line is followed through Bengal to the Northwest Provinces. The meteorological conditions will probably be more favorable in the neighborhood of Bombay, and the majority of the most suitable stations will be reached from the west coast, though some of the observers will probably go to Calcutta as a starting point for Buxar and Ghazipur. Sir J. Norman Lockyer and Mr. Fowler will, it is stated, be stationed near Ratnagiri, on the Bombay coast, while the astronomer royal (Prof. Turner) and Dr. Common will take up a position where the shadow track crosses a point on the Great Indian Peninsular Railway. Mr. Newall will go to Wardha by the railway from Bombay to Nagpur, and he will use a large slit spectroscope for determining the speed of rotation of the corona. The Southern Mahratta Railway offers free passes to all observers, and the other railways will make considerable reductions in the fares. The length of the path across India is about a thousand miles, and the width of the shadow fifty miles, so that there is ample opportunity for observation, even in the short time of approximately two minutes. The observations made by the professional or official observers will be made in relation to the results of previous eclipse expeditions; but any observations made independently will obviously be of considerable value.

High Tension and High Altitudes.

"Alpine misadventure is a wide word, and includes victims to pathological conditions unrecognized by the victims themselves, whose sudden fall into a crevasse or mountain torrent is set down to 'loss of balance,' 'misplaced footing,' or one or other of the many mishaps besetting the mountaineer, when syncope due to cardiac lesion was the real cause. In August, 1894, The Lancet pointed out this 'error in classification,' when Baron Paccoy, who had for two days been acting as guide to the Queen of Italy, stumbled and fell into a crevasse on the Lyskamm, not, as was at first thought, by inadvertence in walking, but by instantaneous heart failure occurring at the dangerous spot in question. May not this account for the strange disappearance of Mr. Cooper at Zermatt, now being investigated at the instance of our Foreign Office by the cantonal authorities? May he not have fallen into the Visp when suddenly overtaken by the syncope not unusual in a septuagenarian beside a rushing, brawling mountain stream? The hypothesis is well worth entertaining, strengthened as it is by the circumstances under which, on Sunday, July 11, the burgomeister of a Westphalian town met his death on the Furka Pass. This gentleman, with his wife and a young Italian officer as compagnon de voyage, left Andermatt on the morning of that day for the Rhone Glacier. Everything went well till they came within sight of the object of their journey, when the burgomeister, rising in the carriage to get a better view, had barely uttered, 'Oh! C'est magnifique!' when he dropped down dead. The great altitude, the rarefied air, the high tension—conditions inseparable from Alpine ascents—were too much for a 'chronic sufferer from weak heart,' and he collapsed accordingly. Now, had this syncope occurred at a difficult spot of the Rhone glacier itself, had it supervened on the edge of a crevasse into which the victim fell, would not the incident have been classified as 'accident due to misadventure'—to one or other of the merely pedestrian risks encountered by every Alpine climber? The whole question opens a series of considerations very gravely present to the Swiss medical faculty, in view of the multiplication of such engineering enterprises as the Jungfrau Railway, for example, which will shortly be 'ballooning' passengers of all ages and bodily conditions to a height of over 12,000 feet above the sea level. At a congress of the said faculty, held some time ago at Arona, the perils and the precautions incidental to such railway development were fully discussed, and an impressive warning was given to the traveling public not to venture on rapid ascents above the snow line without previous sanction on the physician's part. To no section of that public is the warning more immediately addressed than to the British, who, after the exhaustion of the London season or a nine months' spell of work, professional or other, are found thronging every Swiss mountain inn, and in sheer holiday exultation qualifying by every kind of imprudence for some such fate as comes under the all too elastic heading of 'Alpine misadventure.'"—Lancet.

Operating Warship Turrets by Electricity.

On November 5 a trial was made of the electrical equipment for the turning of the large turrets of the United States cruiser Brooklyn, at the Brooklyn navy yard, which was very successful. The trial lasted two hours. The great turrets were moved in all directions, rapidly and at slow speed, and so accurately that the guns could be quickly trained on the target, much easier than with compressed air or hydraulic power. The apparatus is so simple and works so satisfactorily that the turrets of the battleships Kearsarge, Kentucky, Illinois, Alabama and Wisconsin are to be equipped with the same mechanism. The power is derived from the dynamos used for the electric lighting of the ship.

A Silver Medal Awarded to the Scientific American at the Brussels Exposition.

We take much pleasure in announcing that a silver medal has been awarded to the SCIENTIFIC AMERICAN display at the Brussels International Exhibition. Notification of the award was sent to the United States Consulate by Mr. Thomas Wilson, Commissioner General of the United States to the Exposition, and was promptly forwarded to this office by Colonel George W. Roosevelt, the present consul.

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By Rail to Hudson Bay.

The project of building a railroad from Winnipeg to Hudson Bay, with a view to connecting the road with a line of steamers, the whole forming a new grain route to Europe by way of Hudson's Straits, has long been familiar. But while that scheme is still under consideration, a rival enterprise has lately appeared in the proposed extension of the Quebec and Lake St. John Railway from its present terminus to James Bay, which forms the southernmost part of Hudson Bay.

This project, of course, has no new grain route in view, but a plea of special interest just now is made for it as a possible route from Eastern Canada to the Yukon gold fields, says the New York Sun. For this purpose there would be water travel by Chesterfield Inlet and English River as well as by Hudson Bay. In addition, it is hoped that the fisheries, the timber and the minerals of the Hudson Bay region may furnish support for the proposed new road.

The existing railway, it appears, is 190 miles long, extending to Roberval, on Lake St. John, while the distance thence to James Bay would be nearly twice as great, a considerable part of it through a hilly region, but the beginning and nearly or quite all of the northern half lying in comparatively level territory. To the cost of construction would be added that of aiding people to settle on the line of the road, and also of shipping outfits for carrying on the fisheries in Hudson Bay. But these expenditures would bring returns in traffic, and if the great inland sea could be reached in a couple of days and nights from Quebec, there might be some tourist travel, prompted by the facilities for going without discomfort so far north.

On the other hand, a glance at the map suggests that the route to the Yukon by way of Hudson Bay must be tedious and precarious. When, by rail across the continent and by steamer thence to Dyea, people from Eastern Canada can arrive so near the Klondike region, the effort to cross the enormous untraveled area between Hudson Bay and the Klondike could hardly be tempting. Yet there is no saying how much of the continent to the north of us may yet be redeemed and this Hudson Bay project, like the one which seeks a new highway for the wheat of the Saskatchewan region, may some day be carried out.

The Deep Cypress Swamps.

These swamps, lying along the streams in Missouri, are, writes Mr. W. Trelase, director of the Missouri Botanic Garden, in Garden and Forest, most remarkable in their interest.

Except in seasons of great flood, the water of these sunken lands varies little in its general level, and the cypress knees correspond approximately in height with this level for many miles, rising so close together between the trees that only a native can find passageway between them for a dugout canoe. In such a canoe, with an experienced guide, barring the discomfort of the tailor's seat which must often be effected, one can pass with pleasure for hours silently between the trees, now startling a great turtle into a quick plunge from its sunning place on an emergent log, or in turn be startled by the quick call and splashing flight of a pair of mallards, and again recoiling as one's elbow almost brushes against a large water snake—a water moccasin, as it is here called—lying afloat on a snag; drinkable the water scarcely is, but it lacks the turbidity of the larger streams, and, stellate with Cabomba and Jussiæa, and often for miles carpeted with a dense layer of beautiful Azolla with intermingled Lemna, Spirodela, Wolffia, and Wolffiella, it presents a delightful appearance not soon to be forgotten. But the novice who dips into it, or the botanist whose zeal leads him to gather its choice surface coating with incautious hand, is quite likely to learn that in the latter are certain small hemiptera, whose pungent thrust is no less painful than the sting of a hornet, though happily not so serious or lasting in its effects. Here the Nelumbium is at home, and in season its great dew-studded leaves, with the curious bronzed lens of their lower surface conspicuous in the slanting light, and charming creamy flowers, form an almost impenetrable jungle in the waterway. But most marvelous of all are the masses of Polygonum, which, rooted perhaps ten or fifteen feet below the surface, finally emerge, making a tangle on which, in hip boots, one may wade with as great security as on the more solid land. The trees of the deeper water are chiefly cypress (Taxodium) and tupelo (Nyssa aquatica), the greatly dilated bases of which rival anything of the kind that I have ever seen. Not infrequently within the hollow trunk of some old tree may be seen a perfect forest of young knees from its younger neighbors, or even from its own roots, providing the aeration which these would otherwise never get in this region of perpetual water. Now and then old cypress stubs, with gray bark and large branches emerging from the giant trunks close to the water level, stand in marked contrast with the tall, clean stems of a later generation, suggesting the doubtful hypothesis that the strip of land on which they grew has sunken locally below the general level of the stream.

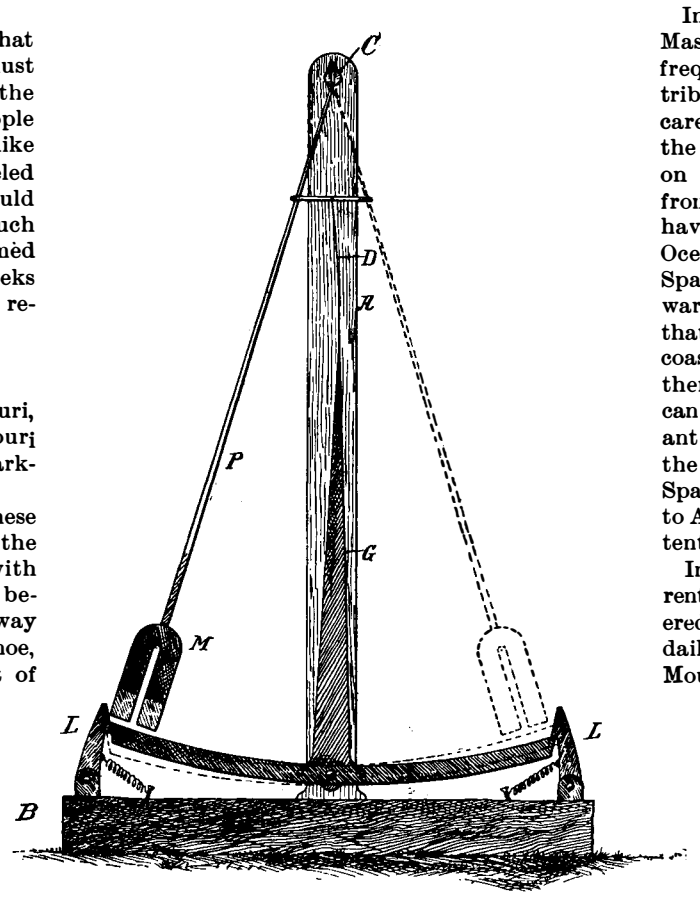
Correspondence.

"Perpetual Motion" Again.

To the Editor of the SCIENTIFIC AMERICAN:

I send you the following, which may be something new on the subject of "Perpetual Motion" so called. If you think it would interest your readers, you are at liberty to publish it. It is with a great deal of interest that I have read your articles on perpetual motion in THE SUPPLEMENT, the earnest search and labor to attain the object thus far being futile. It occurred to me a good many years ago (this being the first time I have offered it for publication, however) that the only way out of the difficulty would be to enlist the aid of the two well known laws, namely, gravitation and magnetic attraction. I put my brains to work and evolved the machine that I submit to you a sketch of, which I hope to make plain enough to be understood. Before going further, would say that I am not sure that it is a failure, as I never gave it more than a crude trial, but I believe that, like all others when tested, it will lack that requisite that all others have lacked—self motion.

My plan consists of a base, B, in the center of which is placed a brass or other non-magnetic material post, A A, near the top of which projects a pin, C, which serves as a support for the pendulum, P, having a permanent magnet, M, attached, which serves a dual need, namely, weight and attraction. Pivoted on the post, A, near the bottom, is a soft iron strip bent to conform to the arc which the pendulum describes in its



A "PERPETUAL MOTION" MACHINE.

motion back and forth. The pendulum is supposed to be started by giving it a full swing, it striking the latch, L, releases the iron strip, so that the magnet can attract it to itself, which it does, and the motion is transmitted to near the upper end, to pendulum, which gives it an impulse to other side, where the operation is repeated. The upper end of rod, G, is made flexible, so that when the latch on left is released, the iron strip attracted upward, it is latched down at the right, thus applying the force to the pendulum gradually, through spring, D; the magnet having the iron in its field of attraction at all times, it is thought, would not interfere with its motion, but let it swing freely under a tension all the time, due to magnetic attraction and gravitation. Whether it would lose its motion by gradually leaving the iron as it passes from side to side is a question I will let some one else solve, if they wish.

G. W. FRANCIS.

Reading, Pa.

Efflorescences in Bricks and Sandstones.

Efflorescences from the materials of our buildings are not ornamental, nor do they render the stones more durable, says The Trade Journals Review About their causes and prevention we are pretty much at sea. Contractors are occasionally required to use stones free of niter; nitrates have, in reality, little to do with the matter, and it is generally sulphates which cause the trouble. Some years ago, the Association of German Architects invited memoirs on the question. The general conclusion seemed to be that prevention was very difficult, and that time would bring its cure. A dissertation by Hans Günther, communicated in abstract in Dingler's Polytechnisches Journal, is not quite so resigned. Günther has evidently made a very careful and painstaking study of this uninteresting subject. The trouble may come from the clay, the water employed during the various stages, the ashes and pyrites of the coal, and from the mortar. The pyrites of the coal may certainly cause mischief, especially because modern practice is in favor of continuous ring kilns, which work with plenty of oxygen; while in the old periodical kilns the atmosphere was frequently reducing, so that little sulphuric acid was formed from the SO_2. The presence of sulphuric acid, we learn incidentally, favors the production of red colored bricks, for it decomposes the yellow iron-lime silicate. But the author attaches more importance to the pyrites in the clay, and to chemical interaction between brick and mortar. He has very fully gone into this inquiry. He found, e. g., that certain bricks remained quite smooth when piled up, and became soon covered with efflorescences when used with a mortar which proved perfectly harmless to other bricks. Almost all clays contain pyrites, which, in the presence of magnesia, give rise to immediate efflorescences; in the presence of lime, only after decomposition with the alkalies of the mortar. That the sulphates are the chief culprits he established beyond doubt. We may mention that the case is different in lavatories where ammonia is constantly liberated and slowly converted into nitrates. As a remedy, Günther suggests to admix baryta, as carbonate or chloride, which would bind the sulphuric acid. The sandstone blocks of the handsome new Town Hall at Hamburg suffer from this trouble.

The Migration of Things and of Memories.

In the minds of some students, says Prof. O. T. Mason, in Science, the question of migration of forms is frequently confounded with that of the migration of tribes. It must not be forgotten by those who are carefully studying the origin of industrial forms on the western world that there were daily mails delivered on the American shore from the eastern continent from the remotest antiquity. The United States navy have been dropping bottles overboard in the Atlantic Ocean, at the Azores, in deep water along the coast of Spain and from the Madeira and the Canaries southward along the coast of Africa. All of these bottles that have been recovered have been found on the coast of South America, on the Antilles, and some of them as far west as the mouth of the Rio Grande. It can be inferred from this, therefore, that every buoyant object which has been dropped into the ocean during the present geological epoch by prehistoric or historic Spaniards, Portuguese, or Africans has found its way to America and been stranded somewhere between the tenth parallel south and the thirtieth parallel north.

In the northern part of the Atlantic Ocean the currents run the other way, and the mails have been delivered from America to Europe. In the Pacific Ocean the daily mails delivered on the west coast of America from Mount Saint Elias southward have proceeded from about the twentieth parallel north, in the vicinity of the Malay Peninsula and Archipelago, thence have traveled through the China Sea and the Japanese Sea to pick up objects designed for the western hemisphere. In the southern hemisphere the mails travel the other way, and materials consigned to the ocean current company were taken from Chile and Peru to be delivered upon the Easter Island and the various groups of Polynesia, some of them reaching as far as Melanesia. In addition to these great mail services of the Pacific, there was a narrow strip of service called the "counter-current," between the equator and the tenth parallel north, the articles consigned to it being delivered on the west coast of Central America.

In the Arctic Ocean the mails proceeded from west to east, passing up through Bering Strait, across the pole, and finding their way first to East Greenland and then around Cape Farewell to the southwestern shores of that great island. The Arctic current from Baffin Land and northward brought the mails from the Eskimo area southward even as far as Charleston, South Carolina. The consequence of such uninterrupted communication cannot be overestimated. All who have studied the arts of primitive races know how quickly their plastic minds respond to a congenial suggestion. It would not even be necessary for a Chinese or Japanese vessel to bring a single living teacher to take part in the pedagogic work of instructing the west coast tribes in eastern Asiatic arts.

The recent example of throwing a stick which drifted from Port Clarence, south of Bering Strait, and was picked up on the shores of West Greenland by Dr. Rink, is one of an interrupted series of communications between one of those great mailing stations and another. A second element in technical pedagogy has not been emphasized by any modern writer, and yet it cannot be overlooked; and that is the survival of industrial processes and productions in the myths and traditions of wandering tribes; so that one of them, having passed over a long area where a certain kind of activity was not demanded, and coming again to a place where the conditions are favorable to its revival, changed a song or an ancient tribal memory into an actual fact again.

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THE STEEL PIPE AND TUBE INDUSTRY.

II.—THE MANUFACTURE OF THE STEEL.

In our previous article we described the operation of the blast furnace plant from the time when the raw materials are brought into the works to the final operation of loading the pig iron into cars for transshipment to the steel department. The loaded cars are hauled up onto a long trestle, from which the iron is unloaded in separate bins according to the "cast," each cast being piled separately from the others. A pig is taken out at random from each lot as it is brought from the furnaces and a small portion is drilled out of it and sent to the laboratory for analysis. The result of the various tests is recorded on a tabulated slate, and when the cupolas in which the iron is melted down are charged, the proper amount of pig iron is selected from the various casts to give those proportions of silicon and sulphur which are most desirable in the molten iron. Anyone unacquainted with the art would suppose that, in a case where the same quality of raw material was used all the time, the composition of the pig iron would have no appreciable variation; but, as a matter of fact, there are variable conditions, such as the difference of temperature in the furnace and the uneven descent of the burden, which cause the proportions of silicon and sulphur to vary considerably.

The pig iron is melted down for treatment in the converters in three cupolas which are approximately of the same construction as the blast furnaces, but much smaller. Each consists of an outer cylindrical shell 10 feet diameter and 30 feet high, which is lined internally with fire brick or other refractory material and is perforated near its base for the admission of blast tuyeres. The charge consists of the graded pig iron, coke and limestone, the latter to act as a flux and incidentally to assist in the fusion of the iron. The cupolas are kept going continuously, and as the iron fuses it is drawn off into the two 8 ton Bessemer converters, where it is decarburized by forcing a powerful blast of air through the body of the molten metal.

In the whole range of the various industries there is probably no one process so famous, or that has exerted such a vast influence upon the progress of civilization, as the Bessemer process. Before its invention the manufacture of steel was tedious, costly, and somewhat uncertain in its results, whereas now the manufacturer is not only able to turn out far greater quantities of steel in less time and for less cost, but he can regulate its chemical composition and its quality with the greatest nicety. It is this perfect control over the composition of the steel that renders it specially valuable—quite apart from its superior strength and other good physical qualities—in certain branches of the iron industry.

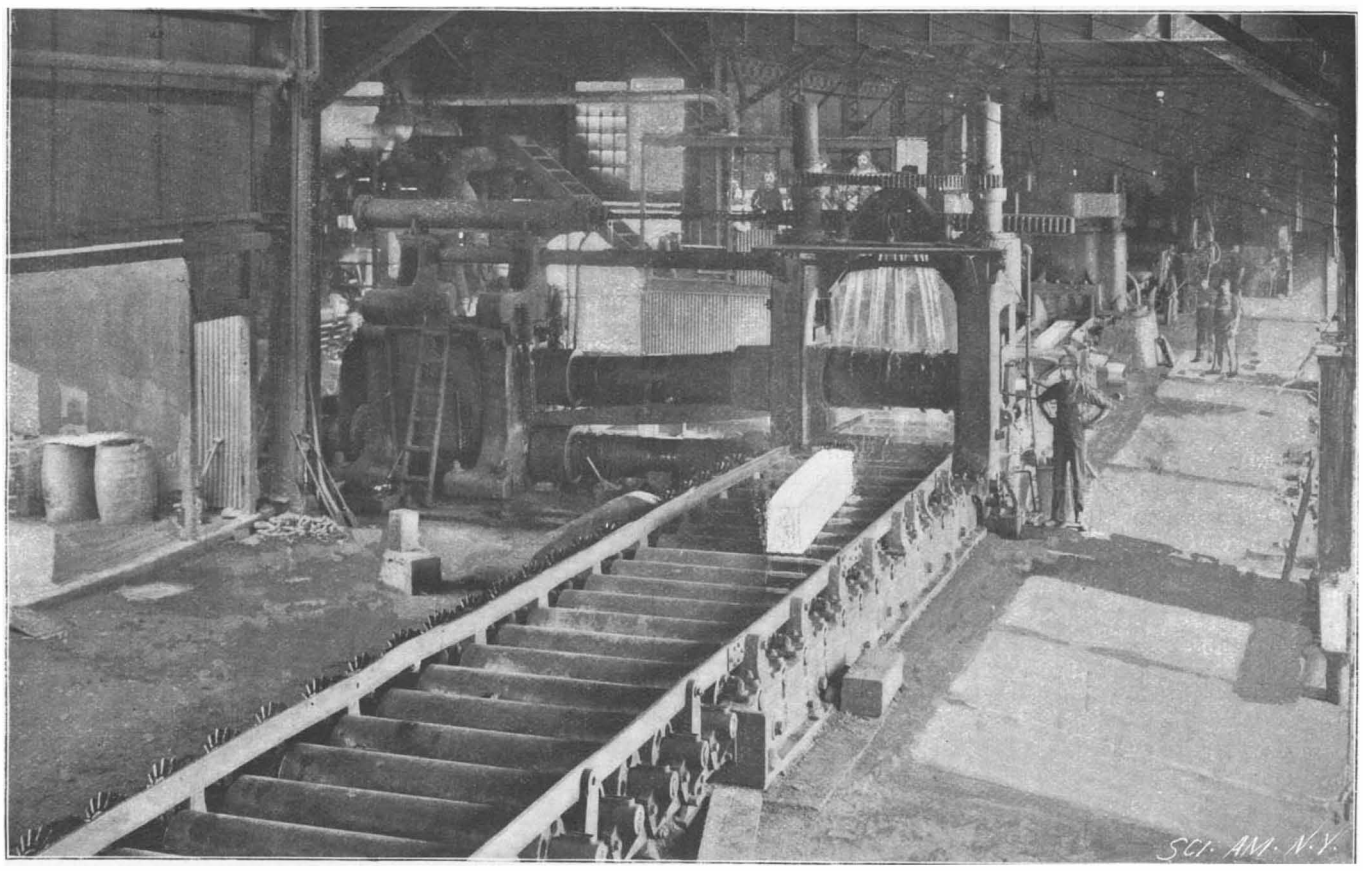

Fig. 6.--BLOOMING MILL IN WHICH INGOTS ARE ROLLED INTO SLABS AND BILLETS.

The National Tube Works Company have found that, to secure a satisfactory result in lap and butt welded tubing, it is necessary to produce a special quality of mild steel in which the portion of carbon is of the utmost importance. This result is secured by the exercise of unusual care during the "blow."

The converter consists of a stout wrought iron shell, eight feet in diameter and fifteen feet in depth, with the neck inclined and tapered at an angle of 35° to the body. The whole of the interior is lined with about nine inches of "ganister," a very refractory siliceous sandstone containing about ninety per cent of silica. The converter is carried upon two massive trunnions, supported on iron standards, which allow it to be swung in a vertical plane through an arc of 300°. The motion is controlled by means of a rack and pinion, the pinion being keyed on the arm of the trunnion, and the rack terminating in the piston of a horizontal hydraulic cylinder, which, by reference to the engraving, will be noticed projecting in front of the converter. One of the trunnions is hollow, and through this the air blast is introduced to a pipe which leads on the outside of the shell to the tuyere box, at the base of the converter. The base is provided with fifteen evenly spaced tuyeres of fire clay, leading from the tuyere box up into the interior of the converter, and each tuyere is perforated with a number of holes three-eighths of an inch in diameter. By this arrangement something like 150 separate streams of air are forced up through the body of the fluid iron during the progress of the blow. To supply the necessary amount of oxygen for burning out the carbon, silicon, etc., from the molten mass requires a very large quantity of air, the two converters requiring the constant service of a pair of compound condensing blowing engines of 1,350 horse power.

When a converter is to be charged it is swung back into a position a little below the horizontal, and a stream of the molten pig iron is run into it through the open neck, until it holds about eight tons. The air blast is then turned on and the converter is swung back to the vertical position. While this is taking place a shower of sparks and burning graphite begins to pour out of the mouth of the converter, accompanied by a small volume of a dull yellow and slightly luminous flame, as shown in Fig. 1. This continues for the first three or four minutes of the blow, during which the graphitic carbon in the cast iron is changed into combined carbon, and the silicon combines with the oxygen of the blast in the form of silica, which in turn forms slag by combination with the iron and manganese. These chemical changes are accompanied by a rapid increase in the temperature of the molten mass and in the volume and brightness of the flame, until what is known as the "boil," or second stage, is reached. This lasts for about eight minutes, and it is marked by a great increase in the volume of issuing flame, which becomes extremely brilliant and yellow. The activity of the "boil" is also marked by the vast shower of sparks (burning iron) and incandescent slag which comes roaring from the mouth of the converter, at times with almost an explosive effect. The spectacular appearance of the second stage is vividly portrayed in the large front page engraving. These brilliant effects are due to the high temperature set up by the combustion of the silica, carbon and manganese, resulting in a violent ebullition of the metal.

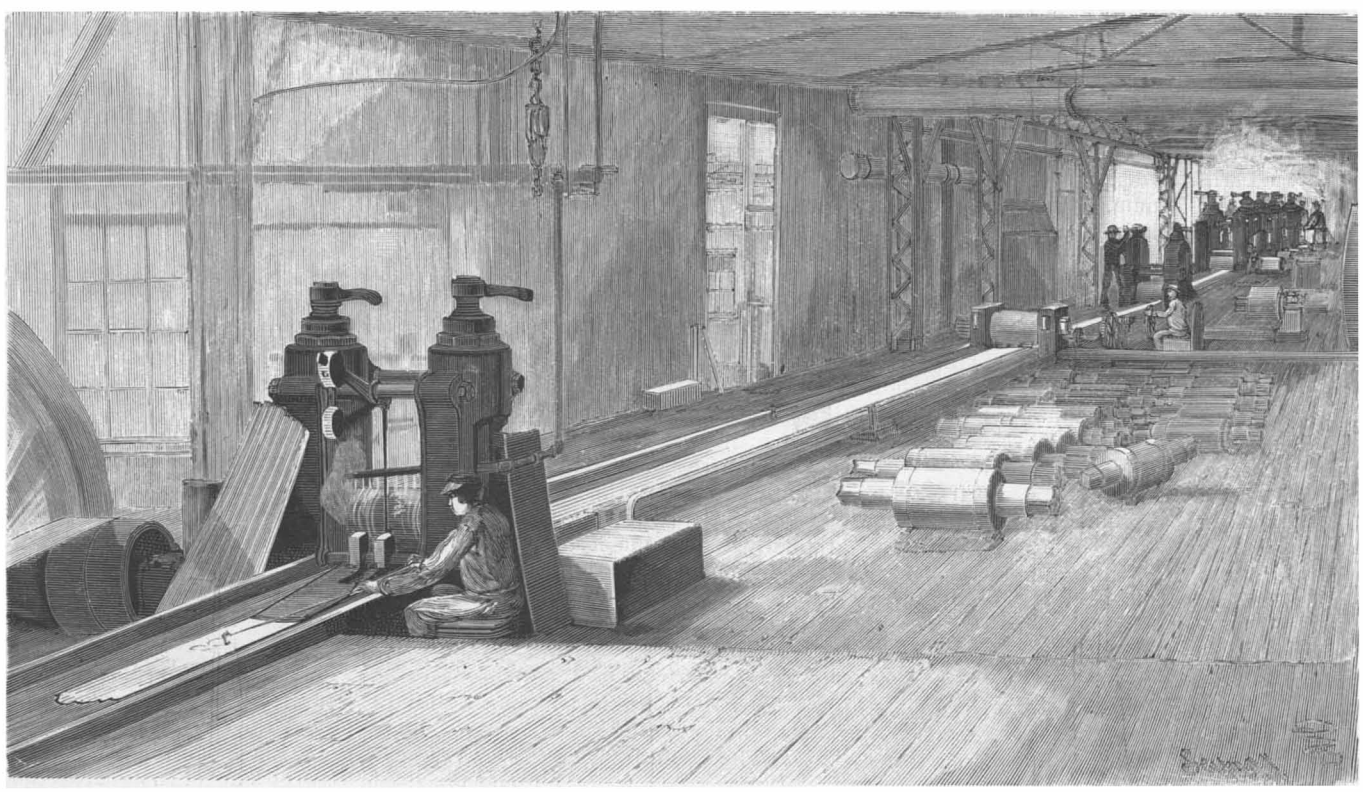

Fig. 7.—THE CONTINUOUS MILL FOR ROLLING SLABS AND BILLETS INTO SKELP.

When the "boil" is completed the flame dies down, loses its brilliancy and takes on a transparent and faint rosy tint, and the shower of sparks becomes less violent, as shown in Fig. 3. These indications mark the third or "fining" stage, which lasts usually for six or seven minutes, and at its conclusion, when practically the whole of the carbon has been burned out of the charge, the flame suddenly dies away, as in Fig. 4, indicating that the blow is over. The blast is now shut off and the converter is turned down into the horizontal position. The final step is to run a certain amount of ferromanganese into the converter in order to impart the necessary proportions of manganese and carbon for the grade of mild steel of which the tubing is manufactured.

The molten steel is now poured out into a large wrought iron ladle, which, like the converters, is lined with ganister. In appearance the ladle is similar to

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those used in foundry work, except that the metal is discharged through a hole in the bottom instead of over a lip or spout at the side. From the ladle the metal is run into cast iron ingot moulds, which are square in cross section, open at each end, and formed with a considerable taper to facilitate their stripping from the ingots. The moulds are placed in pairs upon cast iron trays carried by small four-wheeled trucks. These are hauled into the building and placed four at a time within reach of the hydraulic crane which handles the ladle. The latter is brought successively over the top of each mould and the steel is run in until it is filled. As soon as the ingots have solidified a small dummy engine hauls them beneath a vertical hydraulic ram, from the cylinder of which are suspended a pair of stout links, one on each side. The links are hooked on beneath the lugs which are cast on each side of the mould and the plunger descends, forcing the ingot loose and lifting the mould.

The ingots are next transferred by electric cranes to the "soaking pits," large gas-fired furnaces, in which the whole body of the ingot is raised to a perfectly even temperature, and, as it were, saturated with heat. This is necessary in order to secure a perfectly even flow of the metal under the action of the rolls in the blooming mill.

The blooming mill shown in Fig. 6 is of very massive construction and is driven by a pair of horizontal reversing engines of 3,000 horse power. It consists essentially of a pair of rolls and a long table of rollers which, by means of a countershaft and beveled gears, are made to travel at a uniform speed. The rolls are stepped, the diameter varying according to the amount that the ingot is to be reduced each time it is passed through them. The ingot, weighing two and a half tons, is picked up out of the soaking pits by overhead electrical cranes and placed lengthwise upon the table. It is carried into the rolls, and as soon as it has passed through the engines are reversed, bringing it quickly back for a second rolling. This is repeated until it has been reduced to the desired thickness and width, when it is sheared into lengths, and constitutes what are known as slabs and billets.

These are reheated in a gas furnace and are rolled down in a continuous mill to long thin sheets known as "skelp." This continuous mill, see Fig. 7, is one of the largest in existence, and has a full length over all of 300 feet. Instead of carrying out the successive rollings by reversing the engines and running the piece back and forth through the same pair of rolls, the action is continuous in one direction. The rolls, each pair set a little closer than its predecessor, are placed at intervals down the long table, the space between each successive set being increased to accommodate the increasing length of the strip of metal as it passes through the rolls. The action is perfectly automatic, the slab or billet being put in the first pair of rolls and coming out at the last with the finished thickness and width necessary for the size of pipe into which it will be made in the pipe mill. The skelp, therefore, is rolled in a large variety of sizes, from the thin, narrow strips for smaller pipes up to the great sheets from nine to ten feet wide, used for the 36 inch pipe. In the smaller sizes the width is sufficiently uniform to require no trimming up with the shears, but the large skelp is carried to a table, where it is trimmed to the right dimensions.

It is almost needless to say that samples of the material are constantly being tested at all stages of manufacture in the steel department, and the laboratory is one of the busiest corners in this vast establishment. Samples are taken of the contents of the converter at the end of each blow and of each lot of finished skelp. A strip cut at random from some skelp and tested during a visit to the testing room showed an elastic limit of 42,034 pounds per square inch and an ultimate strength of 63,892 pounds, with an elongation of 23·75 per cent in 8 inches and a reduction of area of over 44·2 per cent.

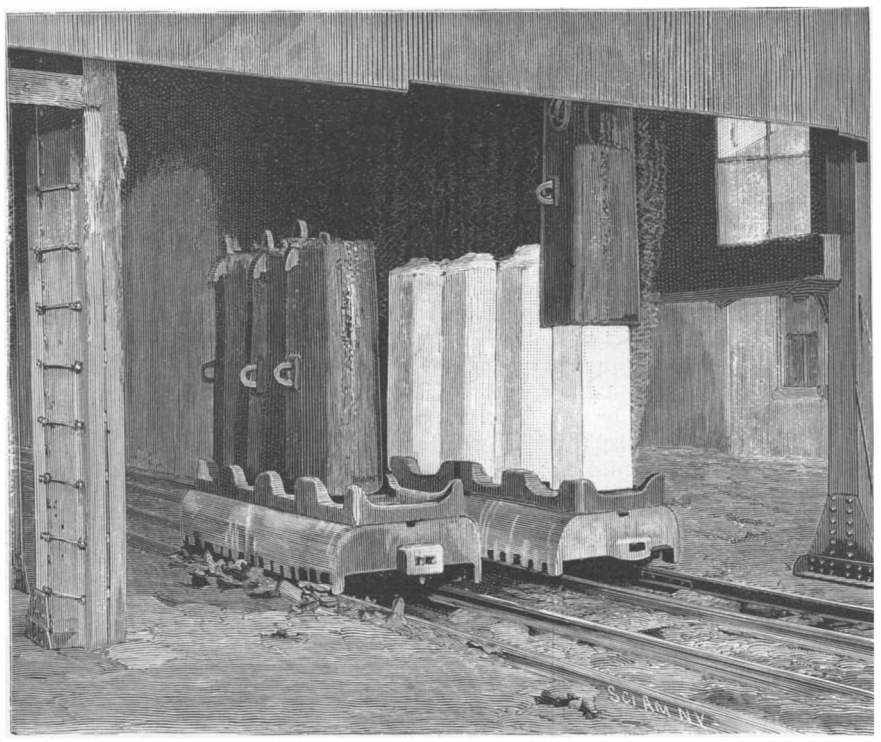

Fig. 8.—STRIPPING THE MOULDS FROM THE INGOTS.

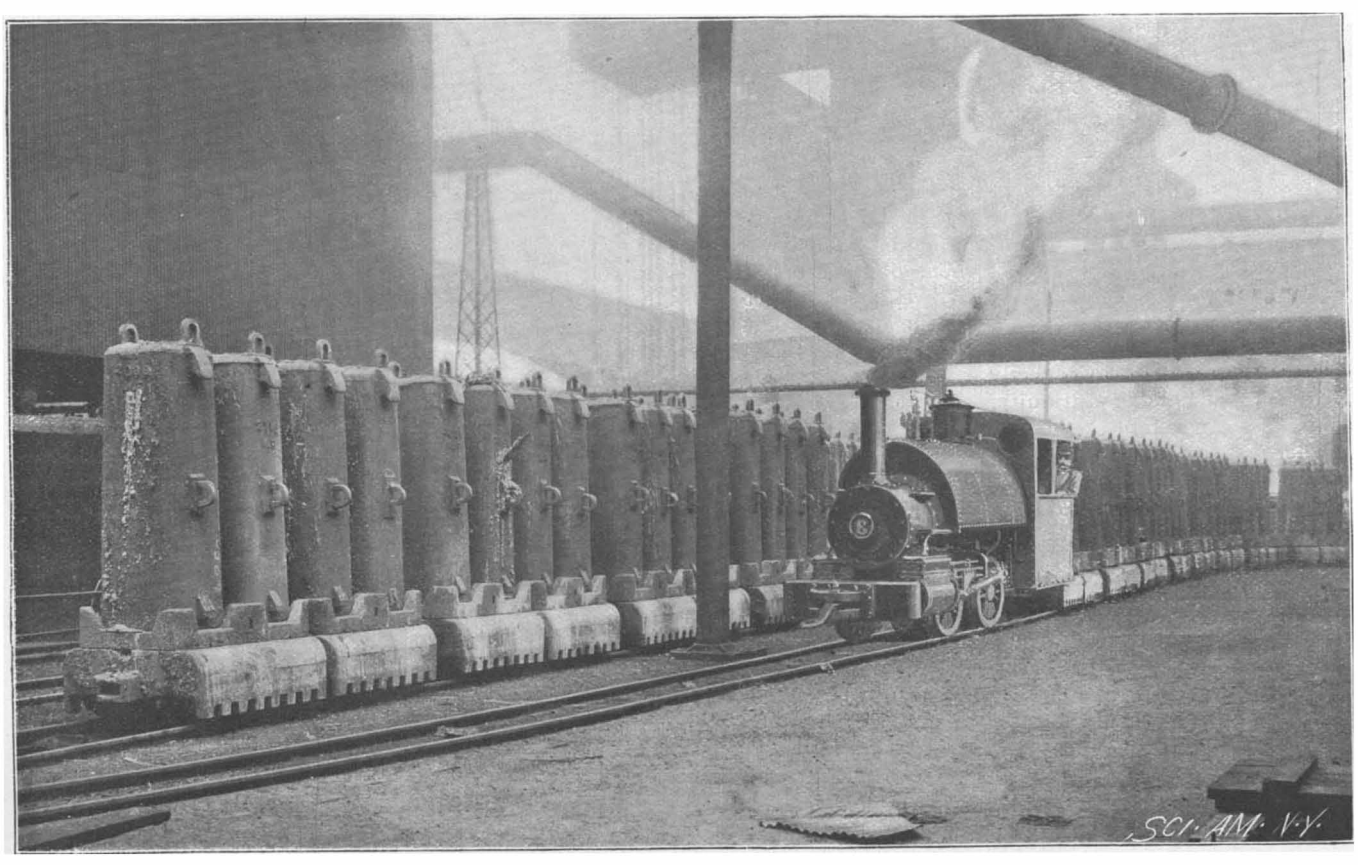

Fig. 9.—A TRAIN OF INGOT MOULDS.

It should be mentioned, in closing our account of the steel department, that while the National Tube Works Company run their works almost entirely upon steel and are satisfied that this material is better suited than iron to the manufacture of pipe, their establishment includes six complete puddle mills, and if a call for it is made, they can furnish pipe in the latter material. The company are, therefore, in a position to judge impartially of the respective merits of iron and steel for tubing, and the fact that they strongly recommend the latter is, therefore, doubly significant.

Indian Heraldry.

The investigation of the North American Indian along lines which have received but little attention heretofore will be of special interest to the student of ethnology, and form an attractive part of the great Indian exhibit at the Transmississippi and International Exposition next year. The result of a thorough inquiry into what has proved a complete system of heraldry in use among certain Indian tribes for ages, with its signs and symbols, mysterious significance and ceremonies, handed down from generation to generation, marks a new departure in the line of ethnological research.

The Indian exhibit contemplated by the United States government at the Omaha exposition in 1898 is being prepared by James Mooney, a representative of the Bureau of Ethnology of the Department of the Interior. Mr. Mooney has devoted many years to a careful study of the American Indian along the line of sacred traditions, religious ceremonies and symbolic signs of heraldry. Mr. Mooney is a white man of scholarly attainments, and an adopted member of the Kiowa-Apache Indians, a nomadic tribe living in the southwest part of the United States. He was admitted to full membership in the tribe several years ago and has spent the greater part of the time every year with them, while quietly pursuing his investigations without exciting the suspicion or distrust of the Indians. It is the result of the knowledge of traditional lore and symbolic language acquired in connection with Indian tribal affairs which Mr. Mooney proposes to depict in an interesting manner at the Transmississippi Exposition. Mr. Mooney had charge of the installation of the Indian exhibit at the Nashville Exposition and he wishes to have more space devoted to that feature of the government exhibit at the Transmississippi Exposition than was given to it at Nashville.

One of the main features of Mr. Mooney's investigations will be a reproduction, historically correct in all its details, of the last great council of the amalgamated tribes of the Kiowa and Apaches, held in June, 1867. The encampment, which at the time the council was held covered a circle of country ten miles in extent, will occupy about four acres of ground at the Exposition. The encampment will consist of 250 tepees. In this camp the tepees of the Indian families are arranged in a great circle, facing toward the center. The tepees are close together and present an unbroken line at all points except at the east, where a wide space is left for an entrance. Each tepee is marked by the emblem of the subdivision of the tribe to which its owner belongs, and these subdivisions are grouped about the circle in the order of their precedence. In front of each tepee is erected a pole, on which are suspended the shield and other war implements of the occupant of the tepee, each shield being emblazoned with the heraldic device of its owner. In the center of the great circle formed by the tepees stands the medicine lodge or temple, which shelters the carved image or idol typical of the sun. This lodge faces the east, and back of it stands the tepee of the priests or medicine men and a small tepee in which the dancers are purified before entering upon their energetic devotions.

After the confidence of the Indians had been secured sufficiently to allow the models of the tepees to be made, Mr. Mooney was obliged to secure the services of one or more Indians in each of the six subdivisions into which the tribe was divided in 1867. The subdivisions were these: Ree, Elk, Kiowa proper, Big Shields, Kiowa-Apache and Black Boys. This work was finally accomplished and the models are now being made. A number are completed, and by the time the Exposition opens the full number will be ready for exhibition.

Mr. Mooney has correct reproductions of the shields and heraldic devices which were used at this celebration under the old regime. These reproductions embrace the many different kinds of decorations, the significance of the device, its origin and the ceremony accompanying its consecration. The complete system of heraldry of these Indians has been formulated, the significance of which has thrown light upon the early history of the tribe and affords one means of tracing the travels and origin of this branch of the human race.

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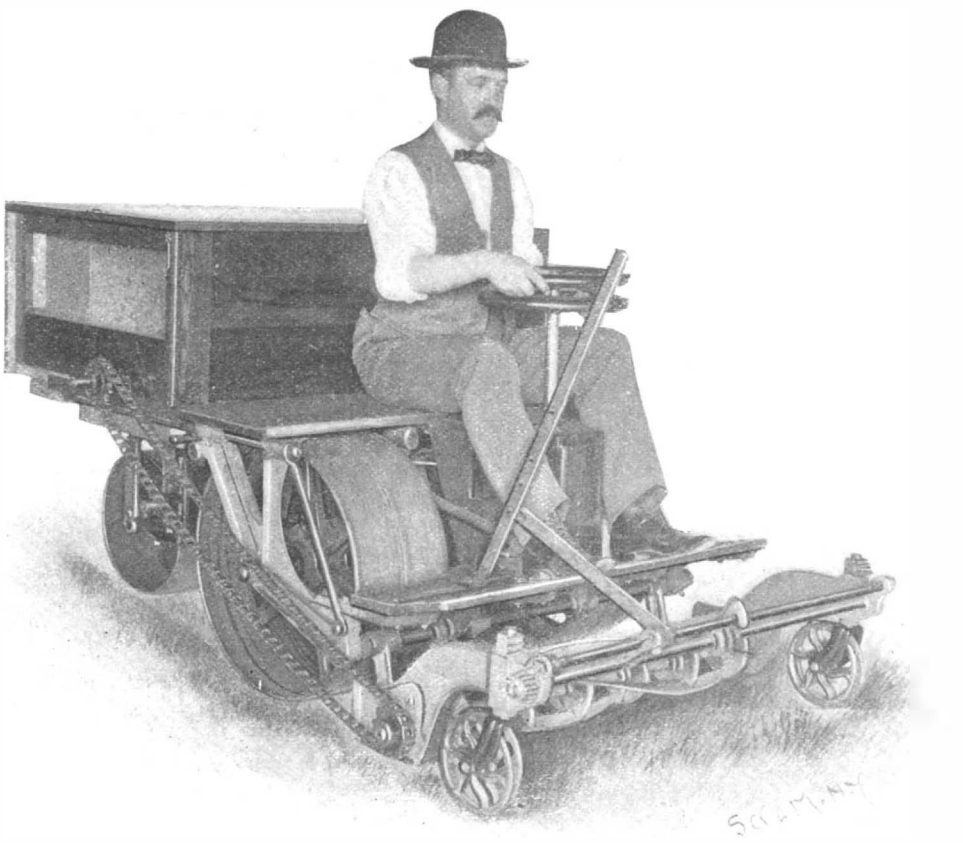
A MOTOR LAWN MOWER.

Those of our readers who look for an early coming of the horseless age will see another sign of its approach in the ingenious machine which forms the subject of our illustration. The ordinary horse-propelled lawn mower used in our parks and larger lawns and on the various recreation grounds is open to the objection that the horse tramps down the grass, especially when it is wet or tender. In the motor mower there is nothing to interfere with the grass before it passes under the cutters, and the great weight concentrated on the three rollers of the machine rolls out the imperfections and leaves a solid, even sod—a valuable feature, especially in golf or other recreation grounds.

The frame of the main body of the machine rests upon three rollers. The first two are the main driving rollers, and the third, which is the rear and covers the stretch of grass left between the former, works as a caster or steering roller. For this purpose a wire rope is fastened to each end of the caster yoke and is carried round a wheel at the lower end of the steering shaft, at the front of the machine. The main frame carries an upper platform on which are placed the gasoline engine and tank, the front of the platform serving as a seat for the driver. The engine is of four horse power, and in a recent test when the mower was loaded with eight men it moved freely on the level, and with three men on the seat it ran up slopes of considerable inclination.

The main shaft of the engine is geared to a countershaft by means of a chain and sprockets. On the countershaft are two friction clutches, one of which carries a sprocket which is geared to a sprocket on the roller shaft. This clutch is in engagement when the machine is running forward. The other clutch is provided with gear which reverses the motion. The two driving rollers run loose upon the driving shaft and are connected to it by two ordinary clutches which are automatically disconnected from the driving shaft when turning curves. The clutches work on feathers on the main shaft, and they are shifted by means of levers whose outer ends engage a quadrant projecting from the back caster yoke. When the caster is moved either way out of a straight line, the quadrant throws out one or other of the clutches and holds it clear until the motor is running again in a straight line. The revolving cutter frame is made separate from the main frame of the machine, to which it is hinged at the front end. It is driven by a sprocket chain directly from the engine shaft. By means of a lever and connecting rod placed to the right of the operator the cutter frame may be lifted from the ground and folded back against the front of the main frame of the machine. The movements and speed of the motor mower are entirely controlled by means of the two hand wheels in front of the operator's seat.

We are indebted for our particulars of this interesting machine to the inventor, Mr. Thomas Coldwell, of Newburg, New York.



A GASOLINE MOTOR LAWN MOWER.

Ancient Wealth.

It would be polite fiction to assert that everybody who looks upon the great monuments of antiquity, the Pyramids or the Coliseum, for example, thinks of the cost, and wonders where the money came from. But when, by chance, a learned person suggests the inquiry, only an idiot, says the London Standard, fails to be struck for a moment. It is so curious that while modern states, with all the accumulated wealth of the antique world at their backs, and the treasures of Mexico, California, Australia, the Transvaal, in addition, have to consider ways and means with anxious care before building a government office, the early monarchs raised palaces and temples by the hundred at will. The thoughtless have ready explanation—slave labor did it all. But, in the first place, the slaves had to be procured somehow—by war or purchase—and either means was expensive. There is a reply to that objection equally facile—the war paid its own cost in loot. But this only leads us a step backward. The loot must have been enormous, and where did it come from? In the second place, those slaves had to be fed, and, however cheap their rations, the sum total must have been immense when such vast numbers were employed.

But captives of war could only do rough work. They might build the Coliseum or the Pyramids, directed by an army of skilled craftsmen. But the sculpture of Assyrian palaces, the painting of Egyptian temples and tombs, must have been effected by artists, probably free, or, if slaves, trained at great expense. When we read that the city of Dur-Sargunu was created on an empty plain, by order of the king, in eight years, standing on a mound of brick 700 acres in area, its walls sixty feet high, broad enough for seven chariots to run abreast, and faced with stone, all the evidence is needed to make us credit the story; but the marvel becomes far greater when we observe the miles of sculptured stone that decorated Sargon's palace with colossal bulls on each side of every doorway. No unpracticed hand carved those reliefs. They are the work of artists, not made for sale when wanted, but to order, each slab telling its fragment of the royal annals. Were all the sculptors of the empire summoned to this task, to be finished in eight years? But the tombs of private individuals in Egypt must have been painted at the cost of the family by masters of the craft. Animals and birds show a skill not to be surpassed. We may be quite sure that work like this was highly paid—by comparison, that is, with slave labor.

So the question recurs, How much gold and silver did these ancients possess? In the Roman time men appear to have been struck with the evidence of vast wealth displayed by their predecessors, such as the Cæsars could not equal. But they escaped the difficulty with ease, by granting them riches literally beyond the dreams of avarice. Dr. Arbuthnot, for example, has patiently reckoned up the amount of treasure heaped upon the pile of Sardanapalus by Athenæus, and he finds that it came to £16,953,120,000 in our money at the least; for if a computation which Athenæus himself suggests be admitted, the total would be about twice as large. After this, the statement of Diodorus that the Pharaohs counted upon a revenue of £133,000,000 annually from gold mines in the Bishari Desert, and drew an equal sum by taxation, is very moderate. But when the same most valuable writer—who talked nonsense only when he repeated the words of other men—comes to deal with Babylon, he lets himself go. There was a gold statue of Zeus—the Greek assigned his own gods to Babylon as usual—forty feet high; of Rhea equally tall, with a lion of gold at each knee, and silver serpents to correspond; Juno weighed 500 talents; in front of her was a golden table, 500 talents, upon which stood two cups, 300 talents each, and three bowls, 1,200, 600, and 600 talents. These ornaments of a single temple represented about £11,000,000, and the building was covered with gold plates. It has been calculated that the statue of Nebuchadnezzar mentioned in Daniel would be worth three and a half millions sterling; that the treasure left by David amounted to a hundred and fifty millions in gold, two hundred millions in silver; but the value of the Hebrew talent is doubtful. We are told that Pytheus, seemingly a private gentleman of Phrygea, entertained Xerxes and all his army—"with most sumptuous feasts," too—and then had £4,770,000 left, or, as some compute, £3,600,000. The tale of Alexander's loot is most wonderful of all, and that is historic. If we entertain doubts, it is futile to express them when the statements are so clear and the means of disproving them absent. In the Persian camp then, and at Babylon, Alexander secured something like £70,000,000; at Persepolis, £180,000,000; at Pasargurdæ, a trifle of £9,000,000; at Ecbatana, £270,000,000; say £550,000,000. And Darius carried off £9,000,000, which his murderers seized.

We come to the prosaic facts which have been collected by several patient inquirers from a note or a hint here and there. Of Egypt, indeed, nothing profitable can be said until the age of the Ptolemies, and little even then. The Pharaohs certainly drew a considerable revenue from their gold mines, and a multitude of inscriptions show them receiving tribute of the precious metal from Ethiopia and Syria in the days of their supremacy. Before and afterward the people were great manufacturers and traders. Ptolemy Philadelphus left £50,000,000 at least in his treasury. Herodotus tells us the revenue of the Persian Empire, under Darius Hystaspes, and the moderation of the sum is assurance that he obtained his figures from a competent authority—it was about £3,250,000; but this was cash alone. Solomon's revenue is said to have been far greater—over £7,000,000 in gold, and as much in silver; but it has been mentioned that Hebrew talents cannot be computed with certainty. That with such an income the Persian monarchs could contrive to hoard the amazing treasures captured by Alexander has often been questioned; but we may suppose that the revenue had increased vastly since Herodotus wrote, and that the taxes in kind and the tribute yielded far more than the returns in cash; and the plunder of Egypt, northern India, Syria, and countless nations must be added. We are told, indeed, that the Macedonian loot represented the accumulation of ages. But it is a relief, as ever in such cases, to get to Rome, where dry facts prevail. Pliny remarks that the treasury had contained over £70,000,000 more than once. This is a reasonable figure. When Augustus had organized the public service, and ascertained precisely what the receipts and expenses of the empire might be, he found that the annual income was about £40,000,000, and he declared that it left a very small balance "to the good." But Cæsar had private resources for any extravagance he might fancy.

Augustus was no tyrant, but people reckoned that during his lifetime he received no less than £32,000,000 by legacy from friends. The savings of Tiberius amounted to £21,500,000, which again is reasonable. Caligula spent all this in a twelvemonth. Some private fortunes may be given: Crassus had about £1,600,000 in cash, and lands to the same value; Seneca, £2,450,000; Lentulus, the augur, £3,250,000. When the villa of Marcus Scaurus was burned, they said that he lost over £800,000. Julius Cæsar declared after the expenses of the prætorship that he was worth £2,200,000 "less than nothing"—owing that sum, with no assets. Upon the other hand, the latest authority who has pondered this interesting question, M. Obreschkoff, concludes that all the money in use at the beginning of our era was but £300,000,000 in gold and £546,000,000 in silver. At that rate Darius Codomanus must have had two-thirds of it in his own hands. This is not so grossly improbable as it seems. His predecessor had sucked all the universe worth sucking. And curious evidence might be given of the excessive rarity of gold in Greece.

A SIMPLE experiment for determining the source of the rays from a "focus" tube is described by Dean Molloy in the Scientific Proceedings of the Royal Dublin Society (vol. viii, part v, 59). Dr. Molloy took a deal board measuring seven inches by five, and into it drove fifteen slender nails in three rows of five. This was attached to the back of a fluorescent screen mounted on a stand so contrived as to allow of the apparatus being revolved in a circle about the focus tube, with the screen always tangential to the circle. By noting the directions of the shadows of the nails, the exact position of the source of radiation could be determined. On adjusting the focus tube so that the central nail pointed toward the platinum plate in all positions of the screen, it was found that this nail gave only a black spot for its shadow, the shadows of the other nails radiating symmetrically from this spot as a center. It followed that the source of radiation was in the line of the central nail produced, and was thus shown to be at or about the center of the platinum plate. Dr. Molloy then proceeded to determine the size of the area of radiation by means of a pinhole image, and found it to be an irregularly circular, ill-defined patch about a quarter of an inch in diameter, coinciding with the patch which first begins to glow when the current is turned on.

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ARCHÆOLOGICAL DISCOVERIES IN NORTHERN AFRICA.

Northern Africa has always been a fascinating country to archæologists. France is here carrying on with energy the great work of retrospective exploration that has been so fertile in results for the last fifteen years.

French Africa has now several fine museums that might be envied by many cities of France, and among which may be mentioned that of Bardo, near Tunis, that of Saint Louis, at Carthage, and the one at Algiers inaugurated in 1896 upon a hill of Mustapha.

Accident sometimes seconds the efforts of scientists. During the demolition of the Arabic and Turkish fortifications at Algiers, there were discovered the debris of the Roman rampart of Icosium, and, on the other side of the gulf, at Cape Matifou, numerous funereal steles and votive objects derived from ancient Rusguniæ. At Castiglione there is a Christian basilica in which has been found an interesting crypt and some baptismal fonts in the shape of a cross. At Cherchell, M. Waille is still carrying on the series of excavations that he has been making for several years. Here there have been found a number of statues and some portraits of the last kings of Mauritania. At Collo, Captain Helo has explored a Punic necropolis of the second and third centuries before our era. At Setif, Lt.-Col. De la Comble has disengaged the ruins of a Roman villa and a small cemetery surrounded with walls, in the center of which stands an edifice composed of several chambers with mosaic pavements. Finally, Timgad continues to emerge from the earth, district by district. The service of historic monuments has here cleared away the region in the vicinity of the capital.

Tunis is year by year revealing to us a little more of its past. Archæology has now thrown some light even upon the old indigenous civilizations. M. Hamy has studied the Berber necropolises of Enfida, and especially Heuchir-el-Hassel, the largest one. The tombs consist of cylindrical bases that support steps in the form of a low cone surmounted by a large slab. M. Leroy has recognized the existence of analogous monuments in the open desert to the southwest of Biskra, on the Wed Djedi side.

M. Novak has explored the Phenician necropolis of Mahedia. Through a rectangular well provided with a stairway, a descent is made into the tombs, each of which comprises one or two vaults wherein the bodies were laid out upon the floor or upon benches or else deposited in graves.

The Roman ruins of Tunis often afford our explorers agreeable surprises. Here, for some time past, there have been met with works of a fine industrial art, if not of art properly so called. At Soussa, upon the site of a rich villa of the first century of our era, Captain Dupont has discovered quite a collection of handsome mosaics. At the entrance there are flowers and fruits and fishing scenes; upon a wall of the hallway, a marine landscape; in the dining room, a true painting representing the Rape of Ganymede; and, all around, medallions in which figure birds, quadrupeds and fishes. In one of the wings there is a large fresco representing the Triumph of Bacchus.

But the most valuable finds of this kind are those made at Oudna. Here, M. Ganckler has unearthed several houses, especially a vast villa of the first century of our era—the villa of the Laberii, decorated with exceptional magnificence. There are here nearly a hundred figure mosaics, many of which have been carried to the Bardo museum. The collection embraces an extraordinary variety of subjects, such as mythological scenes, representations of divinities, figures of animals and plants, farm buildings, scenes of domestic life, and of fishing, hunting, etc. Nowhere else can we so well appreciate what the art of mosaics was in Roman Africa.

During the work of dredging in the port of Bizerte there were fished up numerous antique objects derived from shipwrecked vessels, and especially a magnificent patera with reliefs of very delicate workmanship representing different mythological scenes.

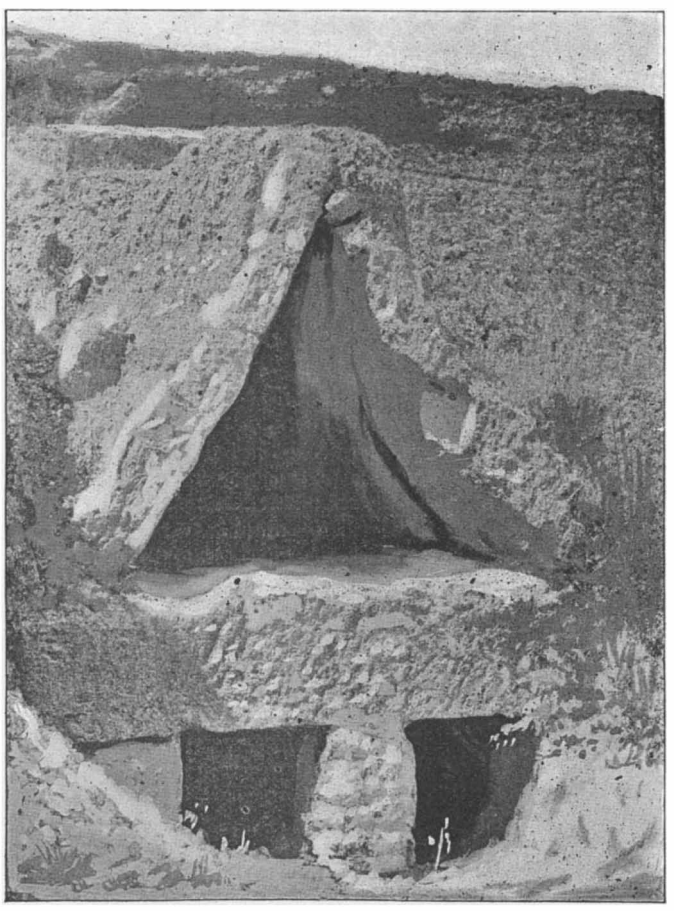
To the Christian epoch belong several interesting monuments which have been studied. At Sicca Veneria (Le Kef) the service of Tunisian antiquities has uncovered the basilica of Saint Peter, which appears to date back to the beginning of the fifth century. At Hadjeb-el-Aioun, to the southwest of Kairouan, there has been unearthed another and very richly decorated basilica. The atrium of this had a mosaic pavement, and the walls of the nave, of the apsis and of the vestries were ornamented with paintings or covered with tiles of terra cotta.

These various African civilizations are met with at Carthage. Not so long ago it was stated that the very ruins of the latter have perished. This is not entirely true. The labors of archæologists have decided against the skepticism of the poets. Although the ground of Carthage has been explored for a long time, it seems to be inexhaustible.

Father Delattre, whose domain this is, has gradually revealed the history of the great city. In recent years he has examined the different Punic necropolises in succession, and has completed his researches in the sepultures of Saint Louis and Bordj-Djedid. He has opened 800 tombs in the district of Douimes alone. The same arrangement is found almost everywhere: Chambers formed in the sandstone, closed by one or more slabs, and into which a descent is made through a well several feet in depth; in each chamber two graves, in each grave two bodies. There are everywhere lamps, pottery, rude vases of diverse forms, plates, and sometimes objects that show Egyptian or Phenician influence.

ENDYMION AND SELENE—MOSAIC DISCOVERED AT OUDNA, TUNIS.

To the west of the city, Father Delattre and M. Ganckler have explored a new cemetery of the employes of the imperial administration. Here and there have been collected mosaics and a few Roman marbles, and, among others, a statue of Empress Julia Domna as a muse.



PUNIC TOMB AT CARTHAGE.

Under the hill of Saint Louis there has been discovered an old subterranean chapel, which is reached by a stairway. The walls of this crypt bear traces of frescoes and of numerous Christian monograms, carved by old pilgrims. It was doubtless an old dungeon, consecrated by the sufferings of martyrs.

Finally, Father Delattre has attacked the amphitheater, of which he has already cleared away the arena. This structure is not in such a state of ruin as has been supposed. It has nearly the dimensions of the Coliseum. The excavations promise to be fertile in results. There have already been found many coins and pieces of pottery, objects of all kinds and a series of curious inscriptions upon sheets of lead. What remains of this celebrated amphitheater, made illustrious by so much heroism, will soon be rendered up to us.—Revue Encyclopedique.

A Method of Detecting Alterations in Manuscripts.

A new use for the vapor of iodine has been found by Prof. Bruylants, of Louvain. By its aid alterations in manuscripts can be detected. It appears that when a sheet of paper which has been sized and finished is moistened and then exposed, after thorough drying, to the action of vapor of iodine, the portion which has been moistened assumes a violet tint, while the remaining portion of the surface appears a brownish yellow. This principle may be used to produce a sympathetic writing, since if we write with water upon the surface of paper treated with ordinary size, the writing will appear in a violet color when the dry paper is exposed to the vapor of iodine. The pale violet upon a yellow ground becomes a deep blue on a pale blue surface, when the paper is again moistened and the characters disappear altogether under the action of sulphurous acid. When a manuscript is suspected of having been fraudulently retouched or altered, the use of the vapor of iodine will often serve to reveal the nature and extent of the alterations. Those portions which have been rubbed will become brownish in tint, and, when a rubbed surface is moistened after exposure to the iodine, it takes a blue color, varying in intensity according to the duration of the exposure. The outline of the rubbed portions remains perfectly distinct after drying, being paler in tint than the rest of the surface. This action is evidently due to the removal of a portion of the starch contained in the size. These reactions also appear upon paper which has been entirely moistened and dried, as in the case of a letter copied in a press, but the indications are somewhat less distinct. The process will also reveal the existence of pencil marks erased by rubbing. Apart from any traces of plumbago which may have remained, the path of the pencil point disturbs the surface of the paper, as would any blunt instrument, and even when the rubbing has been so carefully performed that it has not removed any portion of the surface paper, the marks are made entirely legible when exposed to the iodine vapor. The clearness of all these reactions depends upon the character of the paper, and that which contains the smallest quantity of sizing material will naturally give the least brilliant effects; but in every case the changes above described will appear to a greater or less degree, and the use of the reagent in skillful hands should give material aid in clearing up disputed questions of this nature.—The (London) Architect.

An Interesting Dog Anecdote.

In Mr. Heckethorn's interesting work entitled "Lincoln's Inn Fields and the Localities Adjacent" there is an interesting dog anecdote which is vouched for by reliable witnesses. In the board room of King's College Hospital there is a painting which is a replica of one painted by the celebrated dog painter Yates Carrington and exhibited at the Royal Academy, 1888. It represents an event which occurred on August 1, 1887. On that Sunday morning the hospital watchman heard a dog barking at the door; intending to drive him away, he went to the door, but, instead of one, he found three dogs there. Two fox terriers ran away as soon as the door was opened, leaving behind them a long-haired black collie, with a gaping wound three inches long in his right fore leg, bleeding profusely. The dog was treated as an outdoor patient, his wound was dressed and bandaged, and eventually he went away. Mr. Carrington heard of the story and decided to represent it on canvas. A thick path of blood was still on the hospital steps. Starting thence, Mr. Carrington and the secretary traced the blood all around the back of the hospital to Yates Court. In the boarding between the court and the inclosure of the Law Courts there was a hole just large enough to admit the dog. Below the hole was a piece of glass. While the gentlemen were examining the spot, a well-known bookseller came out and informed them that the two terriers which were actors in the drama were his, and he explained their conduct by stating that living constantly so near the hospital, and having during the day the free run of the neighborhood, they must often have seen patients who had met with accidents in the streets taken to the hospital and that they utilized this knowledge for the benefit of their friend the collie, who frequently passed their street.

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RECENTLY PATENTED INVENTIONS.

Electrical.

BATTERY.—Frank M. Bell, New York City. This invention provides a primary battery with low internal resistance and high voltage and amperage, and in which the negative plate may be recharged when exhausted. The battery has a negative plate formed of a lead grill filled with peroxide of lead and provided with a perforated protecting covering of insulating material and amalgamated zinc positive plates suspended on opposite sides of the negative plate, the negative and positive plates being immersed in an electrolyte, preferably composed of water, sulphuric acid and bisulphate of mercury. This battery generates no fumes, deposits no sediment, and there are no creeping salts.

ELECTRIC CONDUCTOR.—Gorham Gray, Boston, Mass. This conductor is of metal formed with longitudinal and transverse grooves, leaving a core of hard metal and projections of softer metal. The outer surfaces of the projections are corrugated, or formed with transverse grooves, and the metal surrounding the core between adjacent sets of projections is also formed with ridges.

Mechanical.

WOOD TURNING MACHINE.—William T. Jones, New Westminster, Canada. This invention is for a machine for turning fish net floats, providing for sawing the proper length of wood from the strip and then automatically forcing it into position for turning. The machine has a series of fixed cutters, a rotary block carrier to move the blocks against the cutters, means for rotating the blocks, a saw for severing the block from the strip, a reciprocating frame to operate a boring tool, and other novel features.

PRINTING PRESS DELIVERY ATTACHMENT.—Mark N. Cormack, New York City. This invention provides an attachment for web printing presses, designed to deliver a folded sheet free from the smut or smear occasioned by the contact of the freshly printed sheet with the folder and delivery surface, also enabling the printer to readily inspect the work to discover any imperfect folding, blotches, etc., and to allow the ink to set before passing the sheets into the receiving box. The sheets are kept separate to allow the air to reach the entire surface and insure a rapid drying of the ink.

ENDLESS BAND.—Leedham Binns, Philadelphia, Pa. This is an improvement on a formerly patented invention of the same inventor, providing a band for use as a driving belt for mill spindles, the band being very durable and strong and having its terminal portions united in such manner as to render the band of approximately uniform thickness throughout. It is essentially a plaited tubular band containing a filling terminating a suitable distance from the ends to permit of interlacing the ends, this also rendering the band more durable than a band with a thickened joint.

MOTOR FOR VEHICLES.—James M. Trotter, Alma, Cal. This invention provides a motor designed for auxiliary propulsion, arranged to form a brake and to accumulate power during the travel of a drawn or propelled car, wagon or other vehicle on a down grade, and to utilize this power for propelling purposes when going up hill, etc. The invention comprises an air compressor and compressed air reservoir connected with an air motor, and swinging wheels being adapted to be alternately thrown into engagement with the wheels on the vehicle axle.

WELL DRILLING MACHINE.—Francis R. Yearian, Rinard, Ill. This is a machine of comparatively light construction, adapting it to be conveniently moved from place to place on wheels, and in which considerable power may be economically obtained. The frame is mounted on wheels and supports walking beams whose ends are connected by a head block having openings for a rope, a crank shaft having bearings in the frame, and there being connecting rods between the walking beams and the cranks. During transportation the walking beams and derrick are swung down on the frame.

Miscellaneous.

AERIAL MACHINE.—Jacob D. Graybill, New Orleans, La. This machine comprises a gas holder and a car located within the framework of the gas holder, while an air or vacuum chamber protects the car from gas on the front, back and top. It also has a cross shaft on which are ball-balanced crank arms, the latter being used to operate wings at the sides, the wings being also adapted for use as sails when not employed to propel the machine, the wings being independently adjustable. The gas chamber is preferably designed to hold ten thousand cubic feet of gas, and the machine may be propelled by a light gas, air or electric engine.

MACHINE FOR MEASURING CLOTH, PAPER, ETC.—George W. Hyde, Richfield Springs, N. Y. This machine is designed to conveniently unwind a desired length of material from an original roll and wind up the measured length into a roll for the customer. The machine comprises a supporting frame, a swinging rod carrying the roll of material, a winding up spindle detachably mounted in the frame, a measuring roller mounted between the rod and spindle, a lever pivoted at one end in which one of the journals of the measuring roller is mounted, with other novel features.

GRAPHOSCOPE.—Laurance H. Cohen, New York City. In this graphoscope the pictures may be viewed either in panoramic form or singly, the invention providing means for quickly placing in position rollers to which may be attached the tape, sheet or belt carrying the pictures, means being also provided for turning either of the rollers so that the pictures may be wound readily from the right hand to the left hand roller and back, each roller having an independent rotating device. The lens is so mounted on the frame as to be quickly and easily adjustable toward and from a picture, remaining firmly in adjusted position, while it may be entirely removed from the frame when desired.

JOURNAL BEARING FOR TRUCKS.—John E. Rogers, Dendron, Va. This is a box or bearing for small trucks, and especially for dry kiln trucks, consisting of a body or face plate and cylindrical box projecting laterally therefrom, with its outer end closed, while a broad base lip or flange projects laterally from the lower edge of the plate, parallel to the box, all constructed integrally of cast metal. The bearing is held in place without the aid of screws, bolts or nails, a hole being bored in the inner face of the beams and the bearing forced to place, which it retains by friction with the wood and the end thrust of the wheel axle.

CAN SOLDERING MACHINE.—Theodore E. Phelps, Brewster, N. Y. This machine has a table turning on a column, a number of mandrels moving with the table, a fixed table also carried by the column and two soldering irons held by the fixed table, while there are means on the fixed table for moving the irons toward and from each other, and radially with reference to the axis of the moving table. The machine is comparatively simple and inexpensive and automatically solders the overlapping edges of the body, automatically holding the can in position to be soldered, and discharging the soldered body from the mandrel on which it is carried.

VEHICLE SHAFT.—Francois D. Bernier, Paris, France. In draught poles for vehicles, this invention is designed to diminish the liability to breakage in case the horse should fall, to this end employing a joint of novel construction, located on the tongue between the eye which receives the end of the holdback strap and the iron to which is secured the back strap of the harness. The construction between these points is thus made yielding to a large extent, so that the shaft is practically unbreakable.

FOLDING BATH AND WASH TUB.—Hermann J. Gies, Peterborough, N. H. This is a combination device of simple and durable construction, taking up but little space when folded and not in use, and which may be readily converted into a wash tub or bath tub, as desired. The casing is pivoted to the base a short distance from one end, one of the pivots being tubular, and there is in the casing a tub with removable partition dividing it into two parts, a pipe leading from the bottom of each compartment to the tubular pivot, one of the pipes being in the chamber of the casing, while a spring-pressed door is hinged to the bottom of the tub at its pivoted end.

KEY GUARD.—Addison J. Lyon, Mount Vernon, N. Y. According to this invention a spring-controlled stop is carried by a support on one side of the keyhole to normally extend across the keyhole, the stop being movable at right angles to swing away from the keyhole and admit of the insertion of a key, while the spring returns the stop to its normal position afterward. The device is readily applicable to any form of lock, and is so made that when applied to a mortised lock the door will not be mutilated, the device being also entirely concealed by the escutcheon.

DUMB WAITER SAFETY CLUTCH.—Charles B. Cox, New York City. To securely hold the cage in place in case of the breaking of the supporting rope or cable, this invention provides for a vertical rod fixed in the shaft, a casing secured on the cage being formed with a guideway for the rod, while a clamping device journaled in the casing is adapted to engage the rod and clamp it to the casing, a spring plate being connected with the clamping device and attached to the cage, and a staple being adjustably held on the spring plate and connected with the supporting rope.

BANJO BELL.—Albert H. Jarvis and William J. McLean, New York City. A shallow bell formed of resonant material, according to this invention, is adapted to be placed between the head of the banjo and the continuation of the neck. The bell is placed beneath the bridge of the banjo and has a comparatively large opening in its small end, or it may also have the annular section forming the sides of the bell perforated to assist in the emission of the sound waves. The device may be readily attached to or detached from a banjo, being designed to make the tones clearer and more distinct, the tone or timbre of the notes varying according to the material used.

NOTE.—Copies of any of the above patents will be furnished by Munn & Co. for 10 cents each. Please send name of the patentee, title of invention, and date of this paper.

NEW BOOKS, ETC.

HOURS WITH THE GHOSTS; OR, NINETEENTH CENTURY WITCHCRAFT. Illustrated investigations into the phenomena of spiritualism and theosophy. By Henry Ridgely Evans. Chicago: Laird & Lee. 1897. Pp. 297. Price $1.

The present work is by the author of the introduction to our book, "Magic: Stage Illusions and Scientific Diversions, Including Trick Photography." It is an admirable expose of the devices of the pretended mediums and charlatans, with fullest evidence furnished as to their trickery. There has been a large number of works published upon this subject, but most of them have been trifling, catchpenny affairs. The present book is a work of another order and will appeal to all who are interested in the occult. The illustrations are of great interest, revealing as they do the secrets of rope tying, slate writing, materializations, spirit photography, etc. The first part of the book is devoted to spiritualism and the second part to Madame Blavatsky and the theosophists. This is one of the best accounts ever published of Madame Blavatsky's life and work. It contains a synopsis of the theosophist's doctrines and sketch of the successors of the famous Russian priestess, with a bibliography of works on the subject. The author has had sittings with many famous mediums of this country and Europe, but has seen little to convince him of the fact of spirit communication. The slate tests and so-called materializations have invariably been frauds, and the author can be congratulated for the excellent way in which he unmasks these impostors. The book is well printed and is handsomely bound in Holliston cloth.

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Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

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Minerals sent for examination should be distinctly marked or labeled.

(7230) J. D. asks: 1. Is removal of superfluous hair by electricity successful? A. Yes. 2. How many volts and amperes are usually required? A. About 6 cells of carbon zinc battery. 3. Is the puncture of the hair follicle by a needle carrying the current sufficient? A. Yes. See page 538, "Medical and Surgical Electricity," by Beard and Rockwell, price $5.50 by mail.

(7231) W. D. S. asks (1) how to make an electromagnet to lift 75 to 100 pounds 5 inches, with 500 volts, 10 amperes, and use the coil and plunger style. A. The plunger should have the sectional area of 2·5 square inches. A round bar 1·8 inches in diameter will have this area. It should be 18 inches long. The coil requires 2,400 turns of No. 9 B & S copper wire. 2. How to drill a hole in a piece of hardened steel. A. Use a new drill. Sharpen it, then heat it to a low red and plunge it in a solution of zinc chloride (ordinary soldering fluid). If the drill requires sharpening, always reharden after sharpening. 3. The price of S. P. Thompson's "Electromagnet." A. Silvanus P. Thompson's "The Electromagnet and Electromagnetic Mechanism" is $6.

TO INVENTORS.

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NOVEMBER 2, 1897,

AND EACH BEARING THAT DATE.

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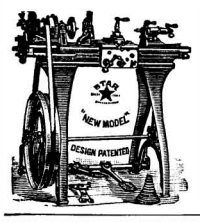

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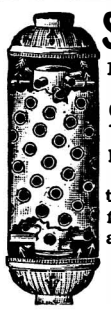

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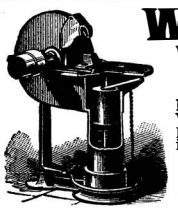

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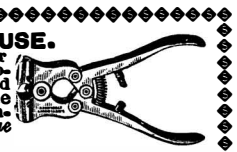

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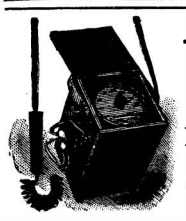

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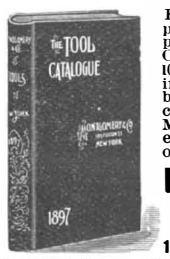

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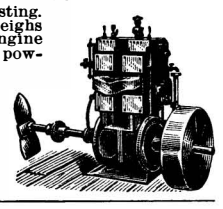

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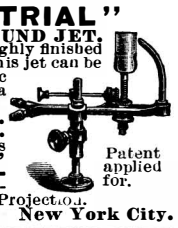

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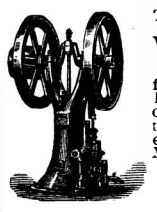

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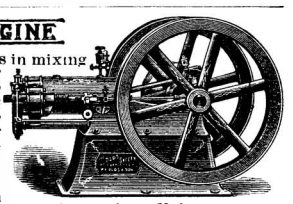

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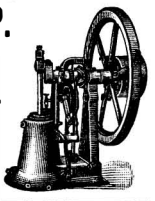

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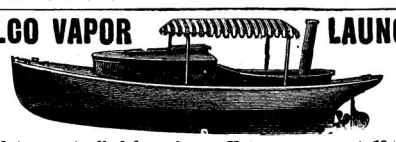

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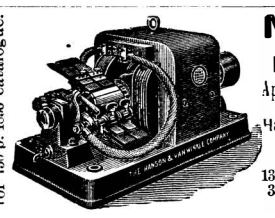

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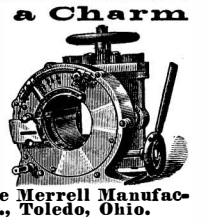

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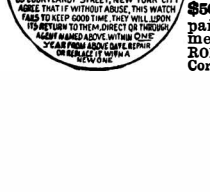
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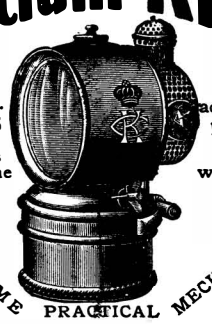
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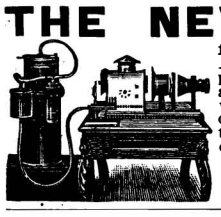
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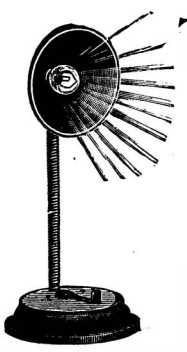
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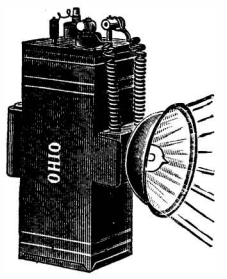

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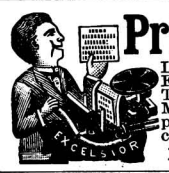

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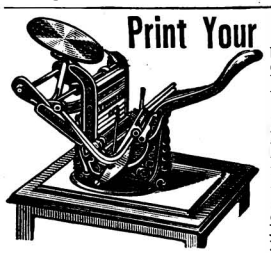
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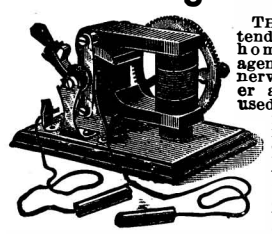
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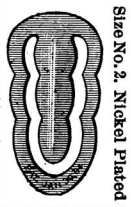
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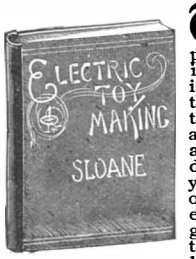

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2. S-P-R--R A Lake partly in the United States.
3. B-S-B-L- A popular sport.
4. W-L--N-T-N A noted General.
5. A-AS-A A country purchased from Russia.
6. C-B- An island now in which a state of war exists.
7. A-A--N Largest River in the World.
8. G-A-T A great General.
9. C-I-A-O A large Western City.
10. B-S--N Said to be the most cultivated City in the United States.
11. K-O-D-K- Where gold has been recently found.
12. S-N-R-N--S-O A large City in California.
13. W-S-I--T-N The first President of the U. S.
14. M-N--YS A popular magazine.
15. A-L-N-A A prominent Southern City.
16. R-S-I- A country which comprises about half of Europe.
17. G--E-E A country recently conquered by Turkey.
18. C-S-I-N A Sea between Europe and Asia.
19. -A-O--O A cake of soap used for scouring.
20. B-R-N A noted English Poet.
21. H-R-A-D One of the oldest Colleges in the United States.
22. -A-N- The largest State in New England.
23. S-A-N A Country in Southern Europe.
24. C-N-D- Great Britain's most valued tributary country.
25. A-C--C The most Northern Ocean.
26. -I-T--N-R- A book to which we frequently refer.
27. W-Y--R A Spanish General.
28. C-L-M--S A man to whom America owes so much.
29. G-E-N-A-D The coldest settled country on the earth.
30. M-S-O--I A long River in the U. S.

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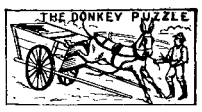

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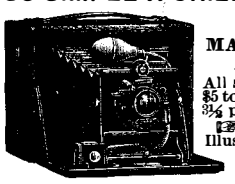

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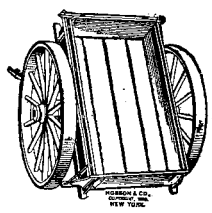

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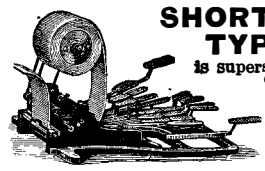

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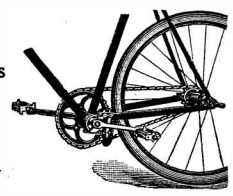

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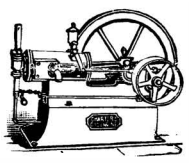

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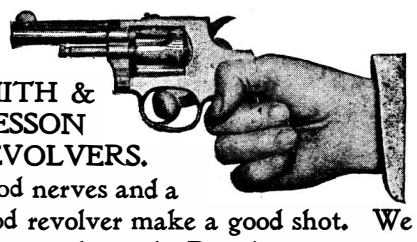

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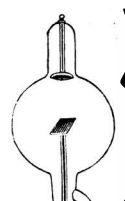

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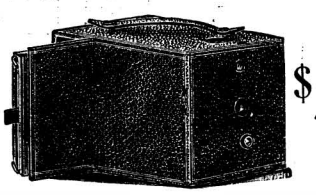

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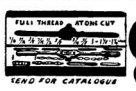

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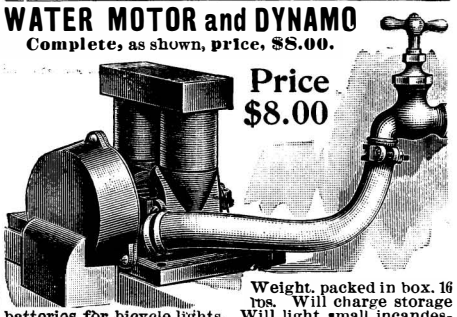

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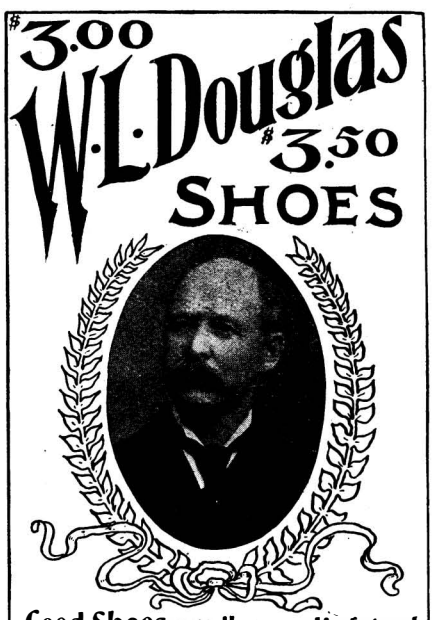

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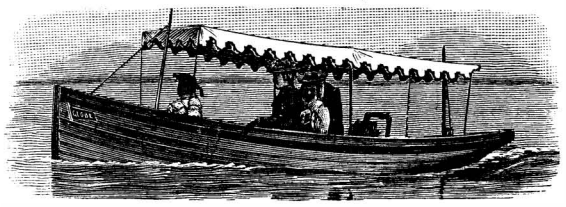

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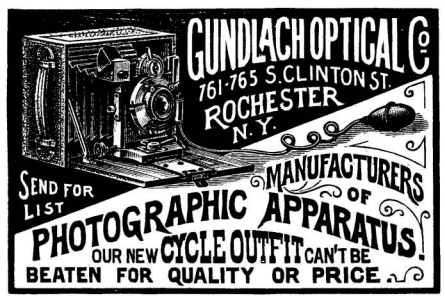

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